THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW

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TRADE UNIONISM OR CO-PARTNERSHIP, WHICH?

THERE have been many attempts to bring about a more harmonious relationship between capital and labour, and any proposal which has this for its object deserves the most careful consideration.

For many years past capital and labour have apparently ranged themselves against each other like two great contending armies on the field of battle. Instead of co-operation there has been antagonism; where community of interests should have been recognised there has been estrangement and strife.

Before any remedy can be applied the disease must be correctly diagnosed, and before industrial peace can be secured, the cause of warfare must be removed. And the cause, what is it? Primarily it is that labour considers it does not receive its fair share of the rewards of industry. When it sees the capitalist manufacturer living in comfort, whilst the manual worker receives what is called "a living wage," it argues that the profits of labour are not only unequally, but very unfairly, distributed. That some men are paid too little for their labour, whilst others take more than their market value, we do not for a moment dispute. There can be no doubt, however, that the promulgation of extreme Socialistic views by some of the Labour leaders has given to many of the rank and file a very exaggerated idea of the real value of labour.

"That we might all be rich" is a very pleasing ideal, and there is a feeling, fostered by the specious arguments of counterfeit Socialists, that if the wages of master and man were equalised all would be rich. It rarely occurs to the workman to test the proposition for himself by the simple rules of arithmetic—it seems so self-evident. He say to himself, "Here am I getting 30s. a week, and my employer is drawing £1,000 a year. Now if we all shared and shared alike we should all be well off." And in his mind he sees visions of £3 to £4 a week. He would scarcely believe it if he were told that £1,000 a year divided among 200 men would not amount to 2s. a week each.

But every sensible workman recognises that all labour has not the same value; the skilled artisan is a higher-paid man than the labourer, and the foreman than the journeyman, and the higher-paid man would strongly resist a levelling up or down of all wages to one standard value. Similarly, organising or administrative work is a higher and more valuable grade of service than manual work, however skilled. Whilst holding strongly the view that inequality of service must involve inequality of the rewards of service, we must not be understood to maintain that all is for the best in the industrial world. No one who has given serious thought to the problem can view with equanimity, or, in fact, with anything but the gravest misgiving, the present order of things.

We have gradually accustomed ourselves to regard

manufacturers as a privileged class, whose chief function is to provide work for the working classes.

This is an entire reversal of the original position in which the maker of things was the employed and the other members of the community were his employers. It was purely for convenience and economy of labour that in the subdivision of toil one member made this, and another that, whilst others tilled the soil or pursued other callings. When we get far enough away from towns, the village blacksmith and the local joiner serve to remind us of the almost forgotten beginnings of the manufacturing industry which has wrought such tremendous changes, and which now plays such a predominant part in our national life. It is well to remind ourselves, lest we forget, that the original function of the manufacturer was to save labour, not to increase it.

We cannot, however, reverse in a moment the conditions which generations have evolved. We are bound to accept the heritage handed down to us, but we may endeavour so to adapt it to present-day conditions that it may bring the maximum amount of benefit to the greatest number of the general community.

As a result of strikes, both sectional and general, the trade in some districts has been so undermined as to induce the employers to seriously consider the closing of their works altogether. Hartlepool is a case in point. The recent proposals made by Sir Christopher Furness to the representatives of the Trade Unions amount to this—viz., either the Trade Unions must give some definite assurance that they will put an end to strikes as a means of settling disputes, or the shipyards under his control will be closed. It is quite impossible to conduct a manufacturing business on profitable lines unless the business can rely upon a regular supply of the necessary labour.

Sir Christopher made two proposals which, briefly, are (1) to sell the shipyards as a going concern to the Trade Unions, and (2) to take the workmen into partnership on a profit-sharing basis, the men buying shares in the business on the instalment plan, 5 per cent. to be deducted from their weekly wage until the total amount of their shares is covered. The workmen would thus become capitalists, and would receive 4 per cent. interest on their capital whether the company divided any surplus profits or not. One may safely prophesy that the Trade Union leaders will vote against both proposals.

Co-partnership is no new idea. There are a number of large manufacturing firms in the country who have carried on profit-sharing schemes with their employés for many years. Some, Tangyes for instance, present their men with shares in the company, and these are entitled to a certain proportion of dividends; others have bonus systems, which are, in effect, a species of profit-sharing. But it is a remarkable fact that whilst the working section of the community are always complaining of the unequal and unfair division of the profits of industry, it is the masters who invariably propose profit-sharing and the Trade Unions who reject it. In 1904 the Federation of Engineering and Shipbuilding Trade Unions publicly and emphatically condemned the system. It condemned "any system of payment of wages except by the hour," and it recommended the societies represented on the Federation "to do all in their power to prevent their members working under any premium-bonus system." In four years there has been time for the opinions of Trade Unions to change, but the reception so far accorded to the proposals of Sir Christopher Furness does not indicate any modification of the attitude taken up in 1904.

With the solitary exception of Mr. Richard Bell, one of the sanest of the Labour leaders, the representatives of Labour will have nothing to do with a proposal which might bring about more harmonious relations between employer and employed. Mr. W. Steadman, representing the Parliamentary Committee of the Trade Union Congress, says that if the Trade Unions wanted to set up in business, they could do so without such assistance as is offered, and he seems to doubt the *bona-fides* of the offer. Mr. Lee, secretary of the Social Democratic Federation, says that his party is "dead against anything in the nature of profit-sharing between employer and employed." The men, in his opinion, "would sweat themselves to increase their bonus." The idea of the Trade Unionist sweating is, of course, not to be thought of. Mr. J. Ramsay Macdonald, secretary of the Labour party, dismissed as absurd the suggestions that the Trade Unions should take over the Hartlepool Shipyards, because under the Trade Union Acts they are debarred from carrying on a business. He points out also that the effect of such a co-partnership would be to destroy Trade Unionism, and herein lies the secret of the opposition of the Labour leaders to the principle of profit-sharing. The moment industrial peace is established on a lasting basis, the occupation of those whose living depends upon the continuance of Trade Unionism will be gone. Hence, in fighting against proposals which make for harmony in the industrial world, they are fighting for their own individualistic ends, and not for true Socialism, nor for the good of the workmen whom they claim to represent.

Profit-sharing schemes in the past have not been an unqualified success. Perhaps the men expect too much of them. The success of the *Maison Leclaire* cannot be repeated in the engineering and shipbuilding trades. In the one case—a painting and paper-hanging business—the raw materials are cheap, the tools and plant require but little capital, and labour is the preponderating factor. The profits in such a business are largely the profits on the labour item. In engineering trades, the raw materials are dear, the plant and tools are expensive, involving very large capital outlay, and the labour item does not preponderate. The profits, therefore, represent interest on capital and profits on material far more than profits on the cost of labour. It would seem, therefore, that the proposal that the workmen should become shareholders in the works is a sound one, their shares being interest-bearing, rather than dividend-earning. Their holding might be supplemented by free bonds, as in the case of Tangyes and others, which would be dividend earning, the workmen being thus directly interested in the profits made, after interest on capital had been paid.

The Trade Union leaders, as might be expected, object to the purchase of shares by the workmen. What they want is a free gift of the works. Everything, like old age pensions, must be on a non-contributory basis. To quote from a resolution passed last week by the Miners' Federation, the Trade Unions will not be satisfied "until the land, minerals, mines, railways, and the whole means of production, distribution, and exchange, are owned and managed by the State for the people." But it is not contemplated that the working classes should be asked to bear any part of the cost of purchase. No, the working classes are not part of the State when the transaction is buying, but only when things are given away, *e.g.*, free education, free food, free pensions. Poor middle class!

Sir Christopher Furness's offer is a serious one, and one which the workers will do well to consider carefully. As he very rightly pointed out, a federation of goodwill between masters and men, and a determination on the part of each to work towards a common end, are absolutely essential if the industries of the country are to be retained. If Trade Unionism stands in the way, so much the worse for Trade Unionism. It must go; that is all.

OUR CONSULAR AGENTS.

We have frequently said in the Electrical Review that there is room for great improvement to be made in British Consular representation abroad. For the responsible powers of the British Government to be cheese-paring in their expenditure in such a direction, or to be neglectful of this important means of rendering valuable assistance to our national industries, is one of the best means of adding to unemployment.

When we cry for the support of home industries we do well to use also every effort to bring in business from abroad—from countries which cannot yet manufacture for themselves—to be executed in our factories, thereby finding work for our own people. When we have sometimes said this before, it has been suggested to us that there is little remaining to be secured as a reward for our pains, but such a remark displays either an ignorance of the true position of affairs or a desire to lim

competitive effort while one is engaged securing the plums. Some of the most prosperous engineering firms in the United Kingdom at the present time are successfully engaged very largely upon such foreign undertakings. Sir William Mather's advice of a few years ago showed that these foreign endeavours were some of the best-paying undertakings that Mather & Platt, Ltd., were occupied with at their extensive Salford works. Mr. John Kerr has just told his shareholders that the works of Dick, Kerr & Co., Ltd., are very largely employed upon business for foreign parts. We know, too, how well some of our Continental rivals have been repaid for their enterprise in bringing their powerful commercial and financial skill and organisation into some South American and other fields.

It seems to us an altogether lamentable and unreasonable attitude to give way to hair-tearing excitement about the more favourable position occupied by our rivals in the capturing of foreign markets when we are nationally guilty of lethargy in Governmental trade representation in countries where business might be secured which would feed our own people out of the wages that they would then earn by honest work. It is our opinion that our shortcomings in this respect could be made good by the laying out of an additional few hundreds of thousands of pounds a year, enabling us to make a suitable selection of independent and efficient trade representatives (rather than of highly-educated classical scholars of the diplomatic service type), aided by a modernly organised and equipped intelligence service.

If the expenditure of even half-a-million annually added to our present burdens were to aid our industries to a reasonable extent, it would be an investment well worth the while, for there would be "less crying in our streets," because our factories would be giving employment that is now so much required. If any be found to grumble that such expenditure would be likely to benefit the already well-to-do—the manufacturer or the manufacturing investor—he would, we think, not shut his eyes to the advantage that must inevitably come to the worker from the increased employment that the extra business would give to him.

Nationally, it would seem to us, we are spending our money in the wrong direction. We need to secure more work for which we shall be paid by the outsider, and upon which we can make a profit, rather than to sink money in unnecessary (or ought we to say *not essential?*) relief works, or in doing in the winter what ought to be left for the following summer. To do work too soon only accentuates the difficulty for later seasons, unless we are going to live perpetually in advance of the times. We do not want to be thought to regard the position of the man seeking employment unsympathetically or callously, nor to begrudge reasonable relief in deserving cases, but for the future we should spend our money in trying to secure business which would pay, not in making work whereupon to spend our money. However, we must not allow ourselves to be led off too remotely from the question of this article. Our object is once more to emphasise the importance of our having the most efficient Consular trade news collecting agencies in the world whatever may be the expense, in the belief that what we have at present by no means meets that description, and also in the conviction that the expenditure would pay us as a nation.

And now let us conclude by quoting what really set our pen moving on the matter. A correspondent writing to the *Standard* above the signature "Expansionist," quotes the following from a letter received from a relative who recently visited Russia with the view of introducing the goods manufactured by his firm, and establishing commercial relations with that country. He has just returned to England :—

> Thanks to your introductions, the Consuls were very good, and gave me all the help they could. In fact, at each large town they were very wishful to give advice necessary. I found, however, that the English Consuls have not nearly the number of assistants they should have—all seemed to be overworked—whilst the Germans have a good staff everywhere, with commercial agents ready to furnish their own countrymen with information on the spot as to the requirements of their respective districts. Take the Consular district of Moscow. It comprises 18 provinces, covering 481,486 square miles—about four times the size of the British Isles. There we have only a Consul and one assistant. It is too ridiculous. Take again Warsaw and its teeming industries in Poland. We have a Consul and his assistant there, whereas other Powers are far more largely represented. The same is the case at the English Consulate at St. Petersburg. The German commercial staff, however, in that city is very numerous.

We should be glad if those of our manufacturing firms who make use of the Consular information that is published by us practically every week will express their views frankly to us as to the utility of Consular reports as an aid to business-getting in the countries to which they appertain, and what assistance, if any, they have had from Consular agents direct as the result of their correspondence inquiries. We should also welcome criticisms and suggestions on the subject generally, the prospects of improvement, the warrantableness or otherwise of further national outlay, and so forth.

Financial Support for our Industry.

The chairman of one of our leading industrial concerns in this country, when addressing the shareholders at their annual meeting in London the week before last, expressed the hope that our financial houses would as far as possible support home industries when finding the capital for enterprises abroad, by specifying that the work should be carried out by British contractors.

The advantages gained by our foreign competitors, due to their close alliance with the banks and financial houses on the Continent, are sufficiently understood and appreciated to require no comment here. In this country, however, our manufacturers and contractors have to compete without the financial backing which is accorded to our Continental rivals. It is, therefore, not too much to hope that in those cases where the capital for schemes abroad is found in this country, a preference shall be given to our home manufacturers. It would seem only natural that this should be the case, and as an example, there might be mentioned the case of a railway electrification scheme which Messrs. M. Samuel & Co. are at the present time financing in Japan. It was one of the stipulations made by Messrs. Samuel that the contracts for the necessary work should be placed in this country.

On the other hand, however, we have the recent case of the Moscow tramway contracts, for which scheme the capital was found in London by Messrs. Baring Bros., where no stipulation is made in the direction of influencing the contracts in favour of our home manufacturers. The result of this is that a large portion of the contracts for the Moscow tramways has been placed out of this country.

We have no idea of criticising our financial friends for their action in this direction, but it would certainly seem undesirable that money found in this country should pass into the hands of Continental contractors, when our own manufacturers are in want of work.

It is quite certain that capital found in Germany or Belgium under similar circumstances would not be allowed to pass into the hands of British firms, except on terms very much less favourable than the terms at which the work was offered to their own native firms.

Exhibition Notes.

The most distinguishing characteristic of the Electrical Exhibition which strikes one at first sight is its brilliancy. The superabundance of arc and incandescent lamps, the former largely of the flame type, shedding floods of orange rays, and the latter mainly of the metallic-filament type emitting pure white light, produces an intensity of illumination which gives a most cheerful and attractive aspect to the interior of the building. This result, although accompanied by a certain degree of warmth during the summer-like weather of the first week, was not attended with unpleasant consequences to the eyes, nor did we experience during several days' continuous attendance at the Exhibition anything in the shape of headache or *malaise*, such as not unusually follows a prolonged sojourn in places of this description. This fact alone, though of a negative character, is strong testimony to the hygienic value of electricity as a lighting agent. The condition of the atmosphere of a hall lighted to an equal intensity with gas lamps may be left to the imagination.

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Metallic-filament lamps of some half-dozen different makes, and no one knows how many different names, were everywhere in evidence: this is, indeed, the first important electrical show to be held in this country since the tungsten lamp came into general use, and though the osmium and tantalum lamps paved the way for their younger rival, only now has the latter attained to full development, several British makers having brought forward their new manufactures practically for the first time at this Exhibition.

A result which seems to be largely attributable to the success of the metal filament is the greatly-increased popularity of the small coupled set for lighting country houses and the like. When it is remembered that an installation can now be carried out most satisfactorily with the same wiring as before, but at a low voltage, with a greatly reduced risk of short-circuits or leakage, and with a battery and generating set of one-quarter the capacity for the same amount of lighting, it stands to reason that a large increase of business of this kind may be confidently expected. It is with this in view, no doubt, that so many firms are exhibiting small oil-engine lighting sets, or even complete installations of this kind, and we have no doubt that their anticipations will be justified.

Never, we think, has there been so comprehensive and varied an exhibition of circuit-breakers and motor-starters. These are the leading features of many stands, and are well represented on many others. Every maker of switchgear has his own circuit-breaker, fitted with maximum, minimum, no-volt or reverse automatic trips, or some or nearly all of these attachments. Needless to say, each and every design is the only really successful and perfect one; and, indeed, they all behave admirably when put through their paces. We should add time-limits of various kinds, as well as carbon and magnetic blow-outs, sparking pieces and remote-control to the list of meritorious features, and we are fain to conclude that, unlike most other electrical apparatus, circuit-breakers are still progressing on the upward path of complexity, which has to be traversed by most engineering apparatus before it is brought back, by experience and evolution, to final simplicity and approximate perfection. Motor-starters, too, are in course of development, and have gone far beyond the designs of ten or even five years ago. Many patterns are on view—nearly as many as there are of circuit-breakers—and many of them possess admirable and novel features, fulfilling a large proportion of the multitudinous desiderata of a perfect motor starter. Here again simplicity appears—in many cases—to be a secondary consideration. It is so difficult to endow a piece of mechanism with the intelligence of a vigilant attendant, and the ability to withstand the average user's ideas of careful usage—alias brute force!

Motors at the Exhibition are utterly commonplace; their makers hardly trouble to describe them to visitors—they are all so good, so cheap, so numerous, and so remarkably similar, that enthusiasm wilts. The fact, however, that they are now every-day apparatus, handed down off the shelves like packets of tea, and almost given away without the latter, speaks well for the rapid development of electrical power, and we only hope that some, at least, of the makers are able to realise a modest profit on their sales.

The prevalence of colliery switchgear is a striking feature. Everyone who makes a circuit-breaker or a motor-starter seems to stock an ironclad oil-switch for three-phase currents, with the usual trimmings—maximum, no-volt, &c., automatics. We hope that this means that a healthy demand is experienced for this class of apparatus. Before leaving the subject of switchgear, we may refer to the effect of the Home Office Regulations—still in "draft"—upon the design of motor-starters. Everyone is fitting the no-volt release called for by them to his starters, not only D.C.—on which they were already customary—but also on A.C. starters. Horrible accidents have undoubtedly occurred in their absence, and no doubt many a workman in the future will owe his life to this precautionary attachment, which seems to have given no trouble to the designers. It is frequently substituted for one of the overload trips on a three-phase switch, leaving the overload action on two phases, which is quite enough provided that the neutral point is not earthed.

Lastly, with the utmost diffidence, and in a whisper, we may hint that the display of electrical papers reminds us of that of motors; most of our remarks on the latter may be applied with slight modification to the former. But this is delicate ground. As for ourselves—here first, and here still—we are delighted to record the success, already assured, of the finest Electrical Exhibition ever held in this country.

The Illuminating Engineer.

It was in America, where the cult of the utilitarian is carried to extremes, that the illuminating engineer first saw the light of day. It was in that land, also, whence Mr. H. G. Wells must have derived his inspiration of the Boom Food, that the new idea, fostered by plenty of gas, developed at a phenomenal pace until it came bang up against something less abstract—to wit, æsthetics. To speak more plainly, the illuminating engineer seems to have suffered from a slight attack of swelled head, and the architect has found it necessary to supply the shoe-horn. At least, that is the impression one receives from reading the American technical Press at the present time, when the attacks on the illuminating engineer are only slightly less formidable than the apologies that are being made for his existence. So far, we in this effete island have not had much experience of illuminating engineers as a corporate body. For our sins we have one who adds to the gaiety of nations, and has not yet been excommunicated by the R.I.B.A., or attempted to put a holophane shade behind the sun. Surprising though it may be, in America, where Nature is so colossal and man so poorly imitative, there is yet a substratum of æsthetics—a school which sees beauty in other than man's straight lines, and which, perhaps, looks on sky-scrapers only as a safety valve for philistinism. The architect has revolted against the scientific methods of the illuminating engineer, and has told him not to interfere with that which is holy. It is impossible not to sympathise to some extent with the architect's point of view, however much it may go against the grain from the purely commercial aspect. There is, after all, something of the divine in true art, something which symbolises the characters of nations as of individuals; and if this is subordinated to rigid scientific law, it must make for grossness and materialism. It is equivalent to extinguishing sentiment from human nature. It therefore behoves the illuminating engineer to go more circumspectly about his work, and to remember that if he has got something to teach the architect, the latter has something far older to teach him. Turning now to the British aspect, it is, perhaps, a pity that the science (it is not worthy of the name) of illuminating engineering did not arise before the days of metal-filament lamps. There was then plenty of scope, from both the consumer's and the station engineer's points of view, for a more efficient use of electric light. The former would have welcomed any suggestions for reducing his bill, whilst the latter would have been able to employ the new ideas for business-getting.

But, alas! the poor station engineer has worry enough now with the reduced revenue caused by the new lamps, without the additional burden of illuminating engineering to accelerate his speed towards the gulf that is yawning before him. Therefore, however much we may sympathise with the idea of cheap light, it is necessary to tread warily lest, by grasping after the shadow, we lose altogether the substance. For this reason it is impossible to do more than to take a benevolent interest in illuminating engineering at the present moment, in order that the great electric supply industry may have time to recover from the blow at its vitals which it has received from the metal filament lamp. How soon this will be depends on the perspicuity of directors and committeemen in regard to the system of charging. But that is another tale. For two reasons, then, there is something to be said for the American attitude so far as this country is concerned; but we do not doubt that when illuminating engineering can make legitimate progress in this country, it will work hand in hand with art.

TESTING TABLE CABINET.

By C. A. SMITH, Santiago de Chile.

A simple and convenient testing table cabinet is here described, which will be found very useful in cases where testing apparatus is required to be kept under lock and key, and connected up in readiness to make occasional rapid tests, and when a special test room is not necessary. The cabinet when closed is compact (fig. 1); in the example represented it measures 4 ft. long × 3 ft. wide, and is 3 ft. 1 in. high at the front, and 3 ft. 4 in. at the back. It is a massively built table with a lock-up cabinet constructed upon it, having a sloping top, the object of the slope being to prevent articles being placed upon it. When it is desired to open the cabinet, first the two sliding arms seen in the illustrations at either side of the table are drawn out to a convenient distance. Then the two pairs of double-hinged lids are unlocked at the centre, the various bolts withdrawn, and the lids swung over to the right and left on to the arms, where they rest. The front panel is then unbolted at both ends and withdrawn, to leave the front edge free like an ordinary table (fig. 3). The height of the table is 2 ft. 6 in. The operations of unlocking and opening the cabinet, erecting the scale, switching on the electric light, and adjusting the reflecting scale mirror takes about half a minute. The shelf near the ground is to hold the batteries, empty instrument cases, &c., and has a semicircular front edge to accommodate the operator's legs.

Fig. 1.—Testing Table Cabinet, Closed.

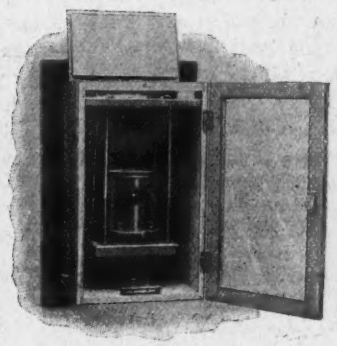


Fig. 2.—Galvanometer in Case.

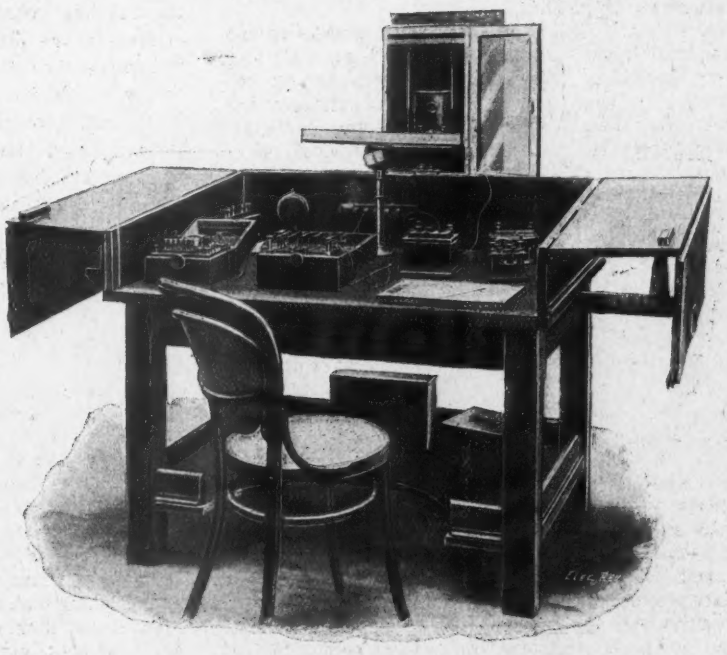


Fig. 3.—Testing Cabinet Open, Ready for Use.

Galvanometer Case.—The case in which the galvanometer is suspended (fig. 2), also designed by the writer to go with his testing cabinet, has perhaps a novel improvement, *i.e.*, the ready means by which the four suspending rubbers may be adjusted and fixed in position by means of clips or pegs at the top of the case. The top hinged lid, shown raised back, when closed down is secured by a loosely-fitting wire nail or pin (the head of which will be seen protruding), which is effectively hidden by the frame of the glazed door when closed and locked. Mechanical vibrations are further prevented from reaching the mirror by connecting fine bobbin wire between the galvanometer terminals and a pair of terminals at the bottom front edge of the case.

STEAM CONSUMPTION TRIAL ON A SMALL STEAM TURBINE.

It is generally supposed that the steam turbine cannot compete in the smaller sizes with other forms of prime mover so far as steam consumption is concerned, and many engineers who would prefer to install turbines, on the grounds of simplicity and lower maintenance costs, have hitherto felt obliged to wait until their requirements justified a set of comparatively large size.

To meet the demand for turbines in the smaller sizes a special type has recently been introduced, which, whilst following the ordinary Parsons turbine in principle, is materially modified in general design.

The ordinary type of Parsons turbine has been somewhat at a disadvantage in the smaller sizes due to its abnorma length, and the Willans-Parsons turbine here illustrated and described has the advantage in the smaller sizes that its economy has been materially improved, and that the length of the turbine has been considerably shortened.

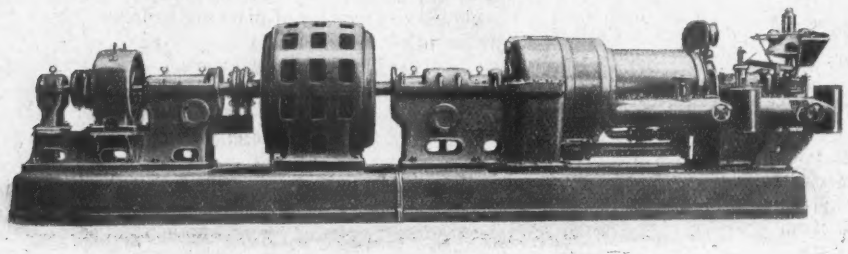
The result of this has been that even in the smaller sizes the turbine is essentially mechanical, and in view of the short shaft between the two bearings no fear need be entertained of possible trouble from the blading.

The illustrations accompanying this article show a turbine of 700 kw. capacity, and turbines of this type are built in sizes down to 200 kw., the speeds between these limits of output being in all cases 3,000 r.p.m. for periodicities of 25 and 50, and 3,600 r.p.m. for a periodicity of 40. Two turbines of this type have recently undergone steam consumption trials before being shipped to Sweden, where they are to be installed in a pulp mill for generating electricity for general power purposes, and the accompanying curve (p. 630) gives the degrees of economy obtained at the different loads up to an overload of 900 kw.

The particulars of the sets in question are as follows :—The turbines are arranged for working at a boiler pressure of 150 lb., and for dealing with a superheat up to 250° F., when exhausting into a vacuum of approximately 28 in.

Alternators.—The alternators are of the three-phase type, 50 cycles per second, 380 volts, having direct coupled on their shaft an exciter, and run at a speed of 3,000 r.p.m.

The condensing plant is of the ordinary surface type, and one condensing set is being installed for dealing with the exhaust steam from the two turbines; the condenser is placed between the turbines, and is capable of maintaining a vacuum of 28 in. when both turbines are exhausting into it.



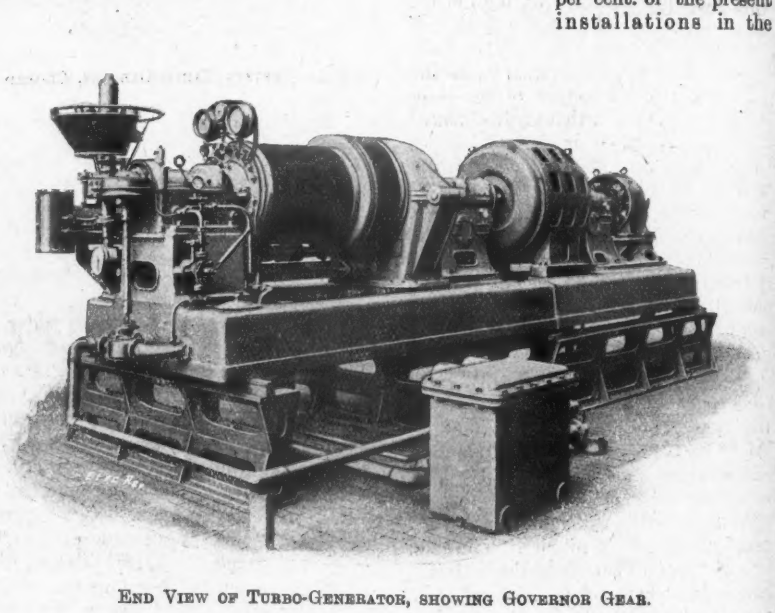
Willans-Westinghouse 700-kw. Turbo-Generator.

Steam Consumption. — The steam consumption curve accompanying this article shows the consumption up to a maximum load of 900 kw., and it will be seen that the steam consumption both at 900 kw. and at the lighter loads, is a record performance for turbine sets of so small an output, the results probably beating the best that has hitherto been possible with prime movers of other types.

As will be gathered from the curve, a consumption of 15½ lb. of steam was obtained at the 900-kw. load, and 16 lb. per kw.-hour at 700 kw., the vacuum being 28·2 in. (bar. 30 in.), and the superheat 240° F.

The transformer shown in the adjoining illustration has been supplied for the purpose of reducing the voltage from 380 to 100 volts for lighting in the offices, &c.

The turbines and condensers were built by Messrs. Willans & Robinson, Ltd., of Rugby, who are the contractors for the installation.



End View of Turbo-Generator, showing Governor Gear.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Auto-Transformers.

In "M. C. St. J. S.'s" reply to my communication in your issue of 18th ult., he states:—"The fluctuation of light referred to does not take place in practice unless the original installation has been very scantily wired," and your other correspondent mentions the wiring of his own house at 6s. per point, and so—inadvertently—possibly supplies the key to the situation. Mr. Good discovered that his house was "wired disgracefully," but, unfortunately, customers are not all electrical engineers, and 6s. to 7s. 6d. per point is by no means a rarity; it is obvious that installations so wired, unless carried out at a loss, will not only be done "scantily," but probably scamped, as with prices so finely cut as at present there is certainly very little tendency to allow for any appreciable margin in the wiring. In fact, in one instance, over £30 was quoted for altering the installation in order to make it suitable for using metallic lamps, hence it may be assumed that installations are generally fairly "closely" wired for the particular pressure of the supply undertaking; assuming that this is 200 volts, the current taken by a 50-lamp installation, using 25 lamps of 50 c.p. (metal), or 16 c.p. (carbon), and 25 lamps of 8 c.p. (carbon) = 12 amperes, whereas, for a 25-volt installation of 50 lamps, using 25 metal lamps of only 16 c.p. (which I consider is insufficient, and sooner or later 25 c.p. will be substituted), and 25 metal lamps of 8 c.p., = 30 amperes, or exactly 2½ times the current of the 200-volt installation, so that the fluctuation and trouble referred to in my letter are thus easily accounted for.

I do not think it would be placing the figure too high in estimating that at least 75 per cent. of the present installations in the West End of London come within this category. In one case which came under my notice a few weeks ago in a comparatively new installation, all went well until a reception took place, when practically all the lights were switched on; then the fuse gave out, and when it was renewed the light was so poor that it practically necessitated rewiring, as it was found that about 30 lights had been wired on one circuit (100 volts) consisting of a pair of 7/22 mains. It is quite conceivable that in instances of this kind the insurance company would step in, and rightly so.

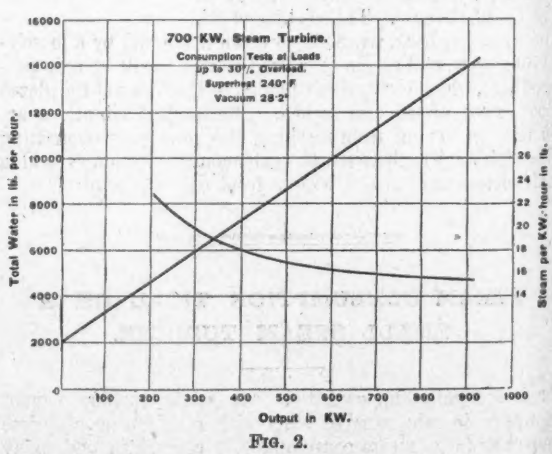


Fig. 2.

There is another phase of this matter which, so far as I am aware, has not been mentioned—viz., the necessity for scrapping all curling tongs, heating irons, kettles, &c., unless the customer is prepared to go to the expense of having the

house rewired for a heating circuit, as I believe kettles, &c., are unobtainable for so low a voltage as 25.

Unfortunately, many contractors in their anxiety to push the so-called auto-transformers appear to overlook or disregard the points to which I have alluded, and I am convinced that in the majority of cases (with the increasing demand for more light) for customers to install auto-transformers will in the end prove troublesome and unsatisfactory, and I have, therefore, in several instances declined to fix them, because I think that such customers would be well advised to await the arrival of the low-candle-power high-voltage metal lamp before going to the expense and inconvenience of making the change.

B. W. H.

October 8th, 1908.

P.S.—Supplementing my previous communication of the 8th inst., it is interesting to note that the Electrical Press of this week contains particulars of a "32-c.p." lamp for 200 volts, which is now on the market.

B. W. H.

October 12th, 1908.

Applications for Situations.

With reference to the letter in your issue of October 2nd on the above subject, as a recent advertiser under a nom-de-plume, it may interest your correspondent to hear the other side of the question. Among the hundreds of replies received in this case, many were in the nature of a bound and printed treatise rather than a concise and businesslike reply to an advertisement; many exceedingly tactless, even impertinent, letters were received, containing most unreasonable stipulations. Ultimately the writer took the trouble to interview many likely candidates in various parts of the country, so that some three months elapsed before the appointment was finally settled.

Those applicants who have not had their testimonials returned may be satisfied to learn that the latter have been retained with a view to future use, should occasion arise.

8,441.

I was rather interested in the letter from your correspondent this week complaining of the scant courtesy displayed by advertisers of posts which appear from time to time in your columns, and I quite agree with all he says. I would, however, go a step further, and suggest that you and your contemporaries should combine and refuse to insert advertisements from those people who will not show their hand. Let applicants know in a straightforward manner who they are dealing with. Men do not want to waste their time and money writing out applications, the recipients of which please themselves whether they reply or not. Personally, I am inclined to think that in a good many cases firms who invite applications through box numbers "ain't the same colour all through." Another objectionable feature about many advertisements is "state salary required." Why? Because they want the cheapest man, who in the end turns out the dearest. My advice to prospective advertisers is to state the salary, or they will be let down, and, perhaps, none too gently, at the finish, and serve them right too.

Surely firms know what a man is worth to them. How is anyone to gather from a short-worded advertisement all the duties and conditions of employment, and what salary to ask? I have applied for numerous jobs, and I never knew whether the salary I asked for was too much or too little or what. I know this—that not in one single instance have I received a reply.

Again, firms would save themselves a lot of trouble wading through applications if they would state remuneration, because no man with any common sense would apply for a job which he had no hope of getting, consequently there would be fewer applications to deal with. So much for this. Turning to another question in close relationship with the above, can you, Mr. Editor, or any of your readers, inform me how it is that many appointments have been obtained in certain departments of the L.C.C., which posts have never been advertised? Is it not the rule for public bodies to advertise and give every eligible man a chance to compete? For months past I have noticed officials from various departments of the respective Corporations or companies obtaining posts under the L.C.C. Why is it? Is it a family party or Freemasonry? Only recently an official from a South Coast town Corporation obtained a post under that august body, and although I have searched every journal appertaining to municipal matters—and the *L.C.C. Gazette*—I cannot find any suspicion of an advertisement.

That favouritism prevails, I have had proofs. About two years, or perhaps more, ago the L.C.C. found it necessary to increase the staff of one of its departments. Advertisements appeared inviting applications, which, of course, was quite in order. These, however, were for subordinate positions; the post of manager of that department was not advertised, for the gentleman appointed was already waiting to step in, long before these particular appointments were made. I knew what would happen, as I was quite "in the know." The salary attached to this post was between £300 and £400 per annum.

Disgusted.

Lot's Road Shut-Down.

A little more light is yet required on the shut-down on Saturday week of the underground railways. We have read in the technical Press that this was due to a series transformer giving out, affecting five 5,000-kw. machines. If we refer to the earlier accounts of the equipment of this station, we shall find it was on the independent unit system, boiler to each turbine, condenser, pumps, and auxiliary gear, all costing a great sum of money. The switchboard had, I believe, several sets of bus-bars for isolated running. Now, to come to the point, how was it that with all these machines on load they were allowed to be run in parallel, when on the alternator side such an elaborate arrangment of independent units had been installed? Surely, with such a load as this, it would have been the right thing to make use of the group bus-bars and to run in such a manner that if one machine failed, it would not affect the whole station; if not, why the independent unit system at all?

The Chelsea power station must be the very place where machines should be isolated, so that in the event of any trouble either in the station or outside the whole of the system would not be affected. This breakdown proves that a central supply station can shut down, and when it does, that a greater number of consumers will be affected than if supplied by a number of smaller stations, each feeding its own district. Only a few days before the L.C.C. shut down. The smaller station engineers will not look on these big power stations as a bed of roses, where one can sleep the sleep of the just at night time, but will thank their stars that though they are a little old-fashioned in their ways, they are safe.

William H. Taylor.

Walthamstow, *October 10th*, 1908.

Publicity Methods.

On page 2 in the *Daily Mail*, of even date, is a long three-column article on home lighting and heating. Much information, correct and otherwise, is given concerning gas for this purpose, while on either side of this article are advertisements on gas mantles, fires, and heaters. Looking more closely than at first into these advertisements, I observed a wee sma' insertion, as if apologising for its intrusion among such literature, advocating somebody's metallic filament electric lamps. Certain of our professional brethren have, at different times through your valuable columns, taught us various elaborate systems by which we might increase our list of consumers. Personal canvassing may produce excellent results under certain conditions, but I am of opinion that systematic and consistent advertising in the leading newspapers and in the local Press, in which technical matter is put in easily understood language, would produce far better results than appears to be credited, so far as the extended use of electricity for domestic lighting, heating, and cooking is concerned.

Now that the Ideal Home Exhibition is in force, the public attention is naturally attracted to the various methods

of lighting, &c., and the time is, therefore, ripe for those concerned in the electrical world to make the best of their opportunities.

P. A. S.

Galway, *October 5th*, 1908.

Cost of Living in Mexico.

Will you kindly inform me as to the cost of living and general health conditions for Englishmen in Mexico, and the general comparison in wages between the latter place and London?

Electrite.

[We have published articles on the cost of living in many foreign countries, but not in Mexico; we should welcome information on this point from any of our readers who are acquainted with this rapidly developing and naturally wealthy country.—Eds. E.R.]

Metallic-Filament Lamps.

It is all very well for the makers of tungsten lamps to guarantee sound delivery under certain conditions, but this does not compensate the contractors for the worry and delay incidental to claiming replacements—quite apart from the trouble they experience in dealing with breakages between them and their customers, some of whom are getting more and more restive of lamps which are so fragile.

It is only necessary to call to mind the Nernst lamp, which, although as efficient, if not more so, than many of the new lamps, was fragile and gave a lot of trouble to consumers and contractors. Think of then and now. Those who are in the habit of passing through the West End in the evening cannot help noticing how rapidly the tantalum lamp is replacing all others in shop windows, clubs and private houses. The reason is not far to seek; it is because this is a commercial lamp which requires no special handling.

W. M. E.

It Proved a Slip.

The article in your last issue by Mr. J. Hardie McLean under the above heading is very interesting, and should be a warning to engineers who control large supply systems, to see that their mains are guarded against the action of subsidence, hill sliding, &c., which constitute a great danger to underground cables, and thereby to the development of electric supply.

In the case mentioned, "nearly 2,000 H.P. in motors, tramways and general lighting were connected." For how many hours this important supply was interrupted owing to the parting of the cable 10 in. *at the joint* is not mentioned, but it must have proved a great loss to all concerned, also possibly, of a consumer or two to the power company.

When we note how marked were the effects of the subsidence on the buildings, surface of the roadway, &c., one is inclined to wonder at the slight effect on the ring main, which was undamaged except at the joints.

This shows that the cable itself withstood the strain, and had adequate expansion joints been made instead of butting the ends of the conductors, no interruption of supply would have occurred.

The illustration of the main being laid in a brick trench is interesting, and this should protect the *cable lengths* from any undue strain from further subsidence; but will it protect the joints, on which will still be thrust their share of strain in pulling along the slack cable, as subsidence takes place?

I consider that one of the best methods of making expansion joints is to connect the cable ends by the medium of flexible leads, which, although rather an awkward job, will allow for the "long pull."

Zig-zag solid copper connectors are sometimes used, and make a neat job, but do not adequately provide for the "long pull."

With regard to the lead sleeve of the joint only showing a gap of 3 in., while the conductor showed a gap of 10 in., I do not agree that this proves that the lead sheathing stretched 7 in., but rather it proves that the conductors contracted.

The main in question is part of a ring main three miles in length, and was laid on the solid system. Now, if the main was jointed in the summer months, or whilst warm from the filling-in material, the contraction of the conductors in the winter months would largely account for the 7 in. difference at the joints.

I have seen many instances of lengthy mains, both single conductor, concentric, and core cables, pulling apart at the joints solely from this cause, in periods varying from one to seven years after the main has been laid.

If greater precautions are not taken to guard against failure of supply owing to these causes, it is probable that engineers will find that their consumers will likewise prove a slip.

W. P. Whitehouse.

Kidderminster, *October 12th*, 1908.

LEGAL.

Rickard *v.* Gateshead and District Tramways Co.

At the Gateshead County Court on 7th inst., John Rickard, of Beaumont Terrace, Westerhope, near Newcastle-on-Tyne, claimed £19 3s. from the Gateshead and District Tramways Co. for damages to a governess car and pony, caused, it was alleged, by the negligence of a servant of the company.

His Honour (Judge Greenwell), without calling upon the defence, said it seemed to him to have been a collision which the driver of the tramcar could not have avoided, and, therefore, judgment would be for the defendants, with costs.

At the same court, George William Anderson, chemist, sued the same company for £14 16s. 6d. for damages to his pony and trap at Wrekenton, caused by the alleged negligence of a tramcar driver. The plaintiff stated that on July 11th he was driving from Wrekenton to Gateshead, and when near Fletcher's Farm his pony, which had always been a quiet one, became restive. There was a tramcar about 80 or 90 yards away, and the plaintiff twice held up his hand to the driver of the car to pull up, but no notice was taken of the signals. When the car was within 30 yards of the trap the horse swerved round in front of it, and a collision followed. The car travelled about 30 yards after the collision, and afterwards the car driver told plaintiff that he had not seen the signals. Further evidence of a similar character was given. No witnesses were called for the defence. His Honour gave judgment for the defendants, with costs.

Brandt *v.* Crompton & Co., Ltd.

In the Lord Mayor's Court on October 8th, before Mr. Assistant Judge Jackson and a jury, Henry Brandt, mica merchant and importer, 28, Minories, E.C., sued Messrs. Crompton & Co., Ltd., electrical engineers, Chelmsford, for £13 14s. 4d., the balance of an account for insulating material supplied. Mr. Comb was counsel for the plaintiff, while the defendants were represented by Mr. Maurice Gwyer. From the evidence it appeared that the parties got into communication with a view to the supplying and receiving of mica insulating rings for use on electric generating machines. A mould was supplied to the plaintiff in order that he might send in the mica rings exactly to the measurements that were required. In December, 1906, the plaintiff gave a quotation for the supply of 10,000, 5,000, or 1,000 mica rings at the rate of 120 a week. The price of the rings was fixed at 38s. per hundred. The defendants entered into a contract with the plaintiff, and the rings were delivered weekly. From time to time the defendants complained that some of the rings were not according to size, and they refused to accept them. As a result of the business relations between the parties down to October, 1907, there were 994 mica rings which had been rejected by the defendants out of the various deliveries which had been made. It was in respect of these rejections that the present claim now arose. The defendants, in the course of the correspondence which had ensued, said that the order given to the plaintiff was for a quantity of mica rings "exactly to our sketch and gauge." The rings in respect of which the plaintiff was now claiming were not supplied in accordance with their instructions, and were useless to them. They had, in consequence, to get their supplies elsewhere. The plaintiff's witnesses said that it was impossible to manufacture mica with such mathematical accuracy as was required by the defendants, and those which had been supplied were such as could be used in the defendants' work. For the defence, it was said that the goods ordered of the plaintiff were to be supplied to a certain specification, stress being laid upon the necessity for accuracy. The plaintiff had agreed to supply according to the specification, and the rings for which he was now suing were not accurate, and were useless to them in the manufacture of their machines. The defendants made

machines on the interchangeable system, and accuracy was of prime importance in all the parts. So far from its being impossible to manufacture mica rings to specification, as alleged by the plaintiff, it was now being done. The defendants had ordered a large quantity of mica rings elsewhere, which were being supplied quite satisfactorily.

The assistant Judge left two questions to the jury to decide: (1) did the defendants order rings to a special specification which the plaintiff agreed to supply; and (2) were the rings reasonably fit for the purpose for which the defendant ordered them, and for which the plaintiff knew they were to be made? The jury answered the first question in the affirmative, and the second in the negative. Upon these answers the assistant Judge directed a verdict for the defendants, and judgment was entered accordingly, with costs.

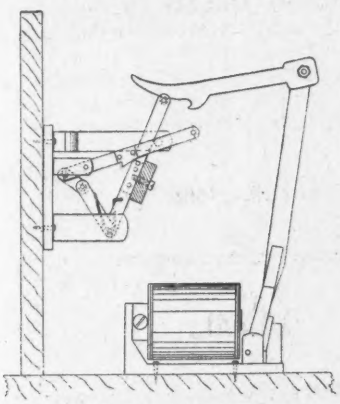


Fig. 1.—Remote Control Switch, Open.

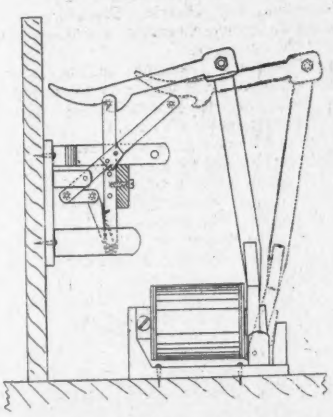


Fig. 2.—Switch Closed.

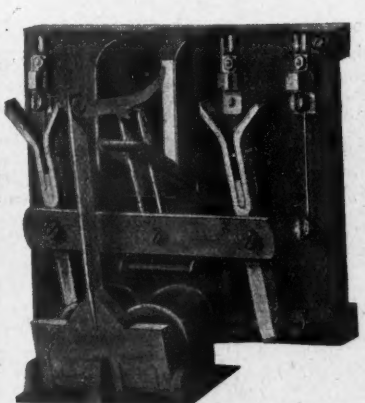


Fig. 3.—Remote Control Switch.

Visits to Manchester Exhibition.—A Lancashire correspondent learns that parties of workmen and officials from municipal and private works, as well as students from many electrical engineering classes in Lancashire, Yorkshire, Cheshire and the Midlands, are arranging for visits to the Manchester Electrical Exhibition.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Remote Control Switch.

A simple and effective switch of this type has been put on the market by Messrs. A. Emanuel & Sons, Ltd., of 9, 11 and 13, George Street, Manchester Square, W., under Blackmore's patent. The device consists of a double-pole switch actuated by an electro-magnet, which is fed from the source of supply or otherwise, and is controlled by a push-button. The first pressure on the button closes the switch; the next opens it, and so on alternately. The switch is locked when closed, and has a quick make and break; the action is powerful and positive, and the magnet is only energised for the time the button is pressed, so that the consumption of energy is insignificant. The mechanism is shown open and closed in figs. 1 and 2, and the complete switch, open, in fig. 3. In fig. 2 the switch has just been closed, and on releasing the button, the the armature of the magnet drops back into the position shown in dotted lines, ready for the opening movement.

The same switch can be controlled by any number of push-buttons in parallel, and the latter may either actuate a battery relay or directly close the circuit of the electromagnet; in the latter case special high-voltage push switches are used. Time switches may also be used to control the switch, which is made for currents from

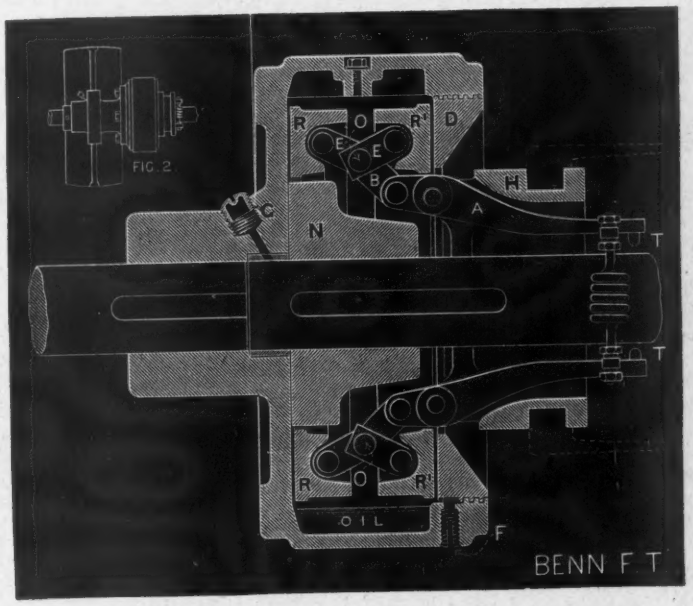


Fig. 4.—Section of the Benn Friction Clutch (see p. 634)

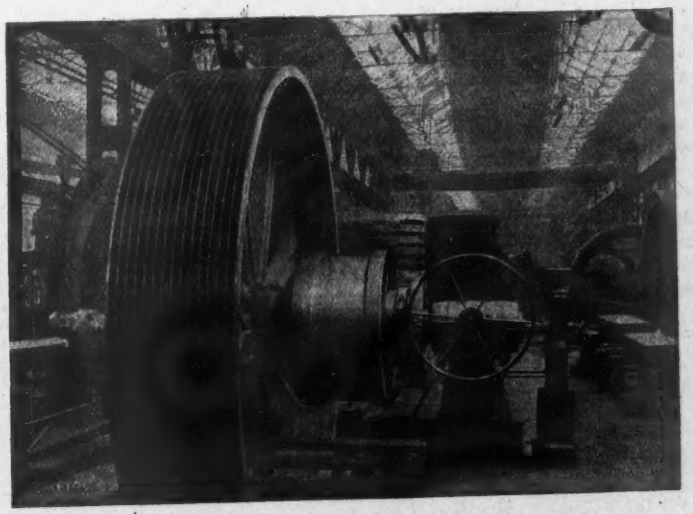


Fig. 5.—Gas Engine with 1,000-h.p. Clutch.

10 to 250 amperes or more. The switch may be used for a great variety of applications, wherever it is inconvenient or undesirable to actuate a switch by hand.

The Benn Friction Clutch.

In this clutch, which is illustrated on p. 633, the pressure for driving is obtained, not by force continuously applied through the striking gear, but by the slight extension of spiral springs. When once put into gear, the clutch is kept so by the continuous action of the springs, which relieve the striking gear of all pressure and render the clutch self-locking without end thrust. This self-locking is obtained without any straining of the parts. The friction plates B B^1, fig. 4, move parallel to the shaft, and not away from it axially; perfect adjustment is possible, and is obtained in the direct line of wear by the screw ring or cover D. The form of the clutch shell makes it available as an oil bath, thus ensuring proper and constant lubrication for all moving parts. The construction and method of working will be easily followed from the illustration.

The driving piece N, keyed to the shaft, carries arms (not shown) which drive the friction rings B B^1 round, while allowing them longitudinal movement parallel to the shaft. The toggles E E move the rings B B^1 into or out of contact with the shell G D, and are themselves brought into their most advantageous position (nearly straight) for transmitting pressure by a forward movement of sleeve H with its attached levers A A and links B B.

The first forward movement of H, and the consequent bringing of the friction surfaces into contact, takes place before any extension of the springs, so that the work may be started as gradually as desired, and by the power of the striking gear only. As soon as the friction surfaces touch, however, pin O becomes a fixed centre, and then the further forward movement of H forces link B past the vertical, and in so doing slightly extends the springs, which thereafter do the work and lock the clutch.

The springs may be adjusted exactly to the required load, to any reasonable overload, or to slip at any overload, and the clutch cannot be forced too hard into gear, as is the case with some clutches in which the pressure is applied by screws.

The adjustment required for wear is indicated, without opening the clutch, by the distance of stops T T from the shaft, and is made, as already stated, by simply turning the screwed cover D, which is then locked by the grub, screw F.

The clutch is perfectly shrouded and free from all dangerous projections, the lever-ends T being covered by a rim on the striking gear, as shown by dotted lines.

The licensed manufacturers, The Unbreakable Pulley and Mill Gearing Co., Ltd., of Manchester and London, stock these clutches for all moderate powers, and have already supplied a large number for all classes of work. The second illustration shows a clutch capable of transmitting 1,000 H.P., constructed by the company, and arranged to work in conjunction with a large gas engine driving textile machinery.

POWER SUPPLY AND ITS EFFECT ON THE INDUSTRIES OF THE NORTH-EAST COAST.

By CHARLES H. MERZ.

(*Abstract of Paper read before the* Iron and Steel Institute, *September*, 1908.)

In this paper, power supply refers to the provision of electricity for industrial use by companies* specially constituted for the purpose. Power supply, though of comparatively recent development, has already had a marked effect upon the industries of the north-east coast. A great saving of coal and reduction of smoke has resulted; there is now, apart from the Power Co., practically speaking no coal burned on the Tyne for power purposes, except in chemical factories.

The application of electricity to all new uses has been facilitated, and new industries have been established in the district purely because of the cheap power supply available. A substantial commencement has been made in the utilisation of the waste heat and gases existing in the area, and in this regard the district occupies a unique position owing to the extent to which its future power requirements can be met by electricity produced as a by-product of two of its largest industries, the making of pig-iron and the making of coke.

The table below summarises the nature and extent of the staple industries of the north-east coast, while the map (fig. 1) shows, in outline, the district and the power companies' systems.

* The companies and municipalities supplying current in different sections of the north-east coast are 12 in number, but as nine-tenths of the total electricity sold is produced by the Newcastle-upon-Tyne Electric Supply Co., the Durham Electrical Power Distribution Co., and the Cleveland and Durham Electric Power Co., and as the author's information is only complete so far as these companies are concerned, the remarks in this paper have application exclusively to these companies.

North-East Coast Industries.

—	Population 1901.	Coal mined. 1906. Tons.	Make of coke. 1906. Tons.	Ironstone mined. 1906. Tons.	Pig-iron. 1906. Tons.	Shipping Built. 1906. Net tonnage.
N.-E. Coast industrial area	2,015,000	52,097,377	7,880,000	6,126,334	3,628,651	630,872
United Kingdom	41,458,721	251,067,628	19,296,526	15,500,406	10,109,463	1,156,771
Ratio :— N.-E. Coast / United Kingdom	4·8 %	20·7 %	40·5 %	39·5 %	36·0 %	54·5 %

It will be seen that in coal, iron and shipbuilding, the north-east coast figures represent respectively one-fifth, one-third and one-half of the nation's output.

Fig. 1.—North-East Coast Power System.

The extent of the area to be covered necessitated the generation of electricity at a pressure and in a form facilitating transmission over long distances, while the nature of the market to be catered for made it essential that the current should be produced as cheaply as possible, which in turn involved the use of an extensive site with ample coal and water facilities. The station from which the greater portion of the current is now supplied—Carville—was begun in 1903 by the installation of 14,000 E.H.P. of steam-turbine-driven generators, and has been increased four-fold during the past four years, so that the generating plant now aggregates 56,000 E.H.P., and Carville has now a greater output of electricity than any other public supply station in Europe. From Carville the transmission and distribution networks extend westwards to and through the city of Newcastle-upon-Tyne, northwards to Blyth, and eastwards along the River Tyne to North Shields, while in a southernly direction the cables at present reach a point some 30 miles south of Carville, and extensions will shortly be completed linking up the northern cable network to the power system which has now been in operation some 18 months in the Middlesbrough district.

Unity of policy and uniformity of system on the part of the three power companies have been secured by working agreements, and it is now possible to obtain electricity on the same system throughout practically the whole area shown on the map. The table below gives the number and size of generating stations and a few leading particulars of the transmission and distribution systems. The capacity of plant installed represents about one-ninth of the total plant installed in the public supply stations of the United Kingdom. But as the power companies are working on a more constant load, *i.e.*, a better "load factor," the electricity actually generated is about one-quarter of that generated in the whole of the public supply stations of the United Kingdom.

A factor invariably of vital importance in the production of cheap current, whether by a public company or by a private manufacturer, is the capital expenditure per useful horse-power of plant. This decreases as the size of plant grows, while the running efficiency at the same time increases. The local conditions governing power supply in this district are :—

1. The low price of coal, enabling manufacturers to produce power themselves at relatively low rates.

2. The fact that the manufacturers' works are mostly of con-

PARTICULARS OF GENERATING STATIONS.

Power station.	Type.	H.P. of plant installed.	Type of current.	Voltage.	Remarks.
Carville ...	Coal-fired	56,000	3-phase 40-cycles	6,000	In operation
Philadelphia	Coal-fired	13,000	3-phase 40 cycles	6,000	In operation
Neptune Bank	Coal-fired	6,800	3-phase 40 cycles	6,000	In operation (stand-by)
Grangetown	Coal-fired	8,000	3-phase 40 cycles	12,000	In operation
Hebburn ...	Coal-fired	4,500	3-phase 40 cycles	6,000	In operation (stand-by)
Weardale ...	Waste-heat*	6,650	3-phase 40 cycles	3,000	In operation
Newport ...	Waste-heat†	4,000	3-phase 40 cycles	3,000	In operation
Blaydon ...	Waste-heat*	3,000	3-phase 40 cycles	6,000	In operation
Capacity of plant installed		101,950			
Dunstan ...	Coal-fired	30,000	3-phase 40 cycles	6,000	Under construction
Bankfoot ...	Waste-heat*	3,300	3-phase 40 cycles	3,000	Under construction
Tees-bridge	Waste-heat†	1,300	3-phase 40 cycles	3,000	Under construction
Capacity of plant under construction		34,600			
Total ...		136,550			

MAIN TRANSMISSION AND DISTRIBUTION NETWORKS.

Main trunk system ...	3-phase 40 cycles	20,000 volts	Underground and overhead
Main high-tension power distribution system—			
Tyne and North Durham area.	3-phase 40 cycles	6,000 volts	Underground and overhead
Tees area	3-phase 40 cycles	12,000 volts	Underground and overhead
Power supply	3-phase 40 cycles	3,000 and 440 volts	Underground and overhead
Railway supply	Continuous current	600 volts	Third rail
Lighting supply (and small motors)	Continuous current	480 and 240 volts	Three-wire
	and 3-phase 40 cycles	440 and 250 volts	Four-wire

* Coke-oven gas. † Exhaust steam.

siderable size, *i.e.*, their individual electrical requirements are large.

3. The existence of large quantities of potential energy in the form of waste heat and combustible gas.

The first and second conditions have been met by the power companies, in erecting their main generating stations (*a*) taking full advantage of the best coal and water facilities available; (*b*) installing plant of capacity much in excess of that which any individual manufacturer, however large, could adopt; (*c*) by catering for all classes of consumers, thereby securing a diversity of load with a resulting constancy of output, and so utilising the plant installed to the best possible advantage. These factors, combined with the employment of a highly-skilled technical staff and attention to numberless relatively minor details, have resulted in securing an efficiency of production much greater than that practicable to any manufacturer producing power merely as an auxiliary to his main business.

Power supply in this district began on the north bank of the Tyne, and although even in this section of the area it is only seven years old, there is at the present moment not a single firm of shipbuilders or engineers on the north bank of the Tyne, inside the power company's area of supply, which does not take 95 per cent. of its power from the company, the remaining 5 per cent. being produced from small gas-engines or from boilers fired with scrap wood. On the south bank of the Tyne progress has, since power supply started, been equally rapid, while in the Tees area, although the power company only began operations in January of last year, they have already connected over 20,000 H.P. of motors.

The fact that the North-Eastern Railway Co. were the first important English railway to electrify a portion of their system, and that they purchased the necessary electricity from the power company, shows that the availability of cheap power is an advantage not only to manufacturers but to the public generally in facilitating the introduction of electric traction. Since the electrification of the Newcastle system, the train service has been more than doubled and the schedule speed improved by 20 per cent. A comparison with other cities at home and abroad shows that no other town of similar population, or, indeed, having twice the population, has so extensive an electrified railway system and so frequent a suburban railway service, and this has, of course, resulted in a large increase of travel.

The application of electricity to rolling-mills of the largest size is one of the most interesting industrial developments of recent years. It had its origin in Germany, and is making rapid progress there. The advantages offered are economy of running, closer speed regulation, better control of operations, and fewer breakages. There are now four new electrically-driven rolling-mills being installed in this area—two by Dorman, Long & Co., one by the Bowesfield Steel Co., and one by a new company now being formed. The electricity for these will be purchased from the power company, so that in this direction also power supply has facilitated new developments.

The supply of electricity to coal mines, beginning as it did not more than four years ago, has not reached the same stage of development as in the case of other industries, though collieries having an output of some 8,000,000 tons per annum are taking, or are arranging to take, practically their whole supply from the power companies. This supply will include, among other apparatus, winders of 1,600 H.P. each; and it would appear that the supply of electricity to coal mines is likely to be of even greater magnitude than the supply to shipbuilding and heavy engineering works. In the latter cases the effect has been to conserve over 50 per cent. of the coal previously burnt for power generation.

Between 6 per cent. and 8 per cent. of the total coal brought to bank is used by the collieries for the purpose of power generation. The application of electricity to coal mines in this district, when as complete as that to the Tyne shipyards, will render available for outside sale an additional 1¾ million tons of coal, equivalent to, say, over half a million sterling per annum.

To summarise present results, the three power companies are now responsible for the supply of current to 80 miles (single track) of electrified railway, four tramway systems, the lighting in towns having populations aggregating over 700,000, motive power to the extent of 85,000 H.P., and electro-chemical works of over 12,000 H.P. The last-named are new industries attracted to the Tyne solely by cheap power supply, and there is every indication that their number will in future be largely increased.

Perhaps the most interesting section of the problem, and one of considerable national importance, is the efficient utilisation of waste heat. The counties of Northumberland and Durham and the North Riding of Yorkshire, last year produced together 7,800,000 tons of coke. Were the whole of the coke produced in retort ovens, there would be available waste gas and waste heat capable of developing

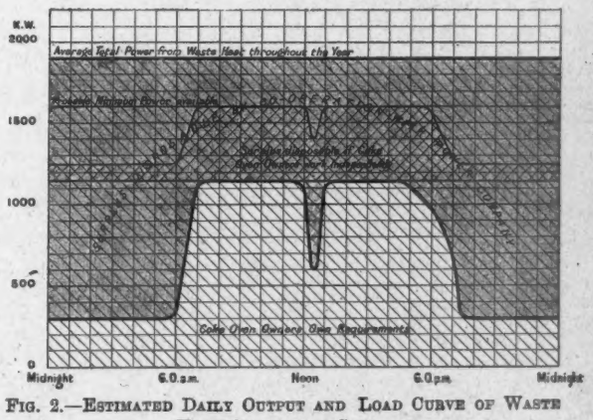


FIG. 2.—ESTIMATED DAILY OUTPUT AND LOAD CURVE OF WASTE HEAT STATION AT CROOK.

Electricity utilised by coke-oven owners at mines and ovens = 5¼ million Board of Trade units per annum. Maximum surplus available for outside sale, if coke-oven owners work independently = 2¼ million Board of Trade units per annum. Surplus disposable by co-operating with power company = 10 million Board of Trade units per annum.

over 150,000 H.P. continuously, if used under boilers, or probably a quarter of million horse-power, if the gas were used in gas engines.

The blast furnaces form a second but less important potential source of power. If gas engines were used exclusively for power purposes, then, after the requirements of the stoves and blowing engines had been met, there would still be available from the Cleveland furnaces a supply of surplus gas equivalent to 61,000 H.P. continuously.

The question then arises as to the best method of turning this "waste heat" and gas to useful purpose.

Dealing first with the waste energy from coke ovens, the batteries of ovens are widely scattered, and are for the most part at relatively long distances from the populous centres—that is to say, from the centres of power demand. In no calculations which the author has made has he been able to establish a case for the transmission of gas for power purposes as against the alternative of converting the gas into electricity and transmitting the power in this form.

In all cases it has been found that a greater profit will accrue to the coke-oven owner by co-operating with a power company, than by proceeding on independent lines. There are three reasons for this:—

1. When a private owner erects a generating plant independently he must install some reserve or spare plant, with a consequent heavier outlay of capital than is necessary to a power company, which, possessing a coal-fired station, need install no spare plant in

any of their waste heat stations, but can, instead, meet any variation of load by the coal-fired station, which also acts as a stand-by against any breakdown.

2. This necessity of putting down spare plant results in smaller, and therefore more expensive and less efficient plant.

3. The power company, having a market for current many times greater than the output of any individual waste-heat station, can run such a station continuously at maximum output, so utilising completely all the current that can be produced; whereas it is impossible to conceive the power requirements of an individual coke-oven and colliery-owner coinciding even approximately over 24 hours with the amount of gas or waste heat available.

The diagram on p. 635, which refers to Messrs. Pease & Partners' installation at Crook, shows the advantage of co-operation very strikingly. It will be seen that the area of the rectangle enclosed between the top line and the base (shown hatched) represents the total amount of power available, that "hatched" (but not shaded) the requirements of the colliery-owner, and that "cross-hatched" the amount disposable had the colliery-owner put in his own plant independently, and been able to find a purchaser; it also assumes that the outside purchaser had approximately the same load curve as the colliery-owner himself, which is a reasonable assumption, unless the power be transmitted long distances, as the only users of power in the vicinity of coke-ovens are other colliery-owners. The area shaded grey represents the surplus power actually used under the co-operative arrangement.

It is more difficult to get out so typical a curve in the case of blast-furnaces, as the conditions vary so widely. Of course, if a company produces pig-iron only, and does not convert the iron into steel, co-operation with a power company is at present, practically speaking, the only outlet which it has for its surplus power.

Capital charges are invariably the controlling factor in the total cost of electricity, and the question whether it is commercially sound for a blast-furnace owner to co-operate with a power company or not can only be decided in each individual case after full consideration of the capital outlay involved, the amount of spare plant that has to be provided, and the degree of coincidence between supply and demand. Given an equitable arrangement, it is clear that the same general arguments in favour of co-operation which hold in the case of coke ovens are applicable to blast-furnaces with steel works attached.

The power companies in this district having their transmission cables interlacing the entire industrial area, and being in a position with their large load already developed to utilise any amount of electricity whenever and wherever produced, are arranging for waste heat stations at different points, turning all the electricity so produced into a common network from which the colliery company, the coke oven owner or the blast furnace owner can purchase any amount he may require, all spare plant and all plant to deal with exceptional peak loads being kept at the main central coal-fired station. Only in this way is it possible to conserve the full national value of the energy now being wasted.

At the present moment the three power companies have at work or in hand five waste heat stations, three in connection with coke ovens and two in connection with blast furnaces. Additional stations are under consideration.

As regards the Cleveland blast furnaces, the adoption of gas engines to the exclusion of all other types of prime-mover still lies some distance in the future, and in the majority of cases in Cleveland it is found that steam blowing engines are used, and that after the requirements of the stoves have been met the gas is practically all expended in raising steam to supply these blowing engines.

To free any substantial quantity of gas for outside power-users would involve, therefore, the substitution of gas engines for the existing steam blowers. Considerations of capital expenditure usually forbid this course, and had it not been for the genius of Mr. Parsons, whose exhaust steam turbine provides another effective, though less ambitious, way of dealing with the situation, the Cleveland furnaces could not be regarded by a power company as an immediately available source of energy.

The author is aware that it has lately become the fashion to argue that the resources of Great Britain have been developed on less scientific lines than those either of Germany or of America. He thinks, however, that the persons urging these views are in the majority of cases omitting to give full weight to local conditions. The fact that the connections to the local power companies' systems have recently been increasing at the rate of 20,000 H.P. per annum, appears to him to prove fairly conclusively that manufacturers on the north-east coast are quick to avail themselves of new developments or of additional facilities.

Discussion.

Mr. T. Westgarth declared that the district, as well as the Institute, owed a considerable debt of gratitude to Mr. Merz, not only for what he had done, but for the way he had put his case before them. Mr. Merz had put before them the benefits of a central system of supply in an excellent manner, but he did not think he had given sufficient credit to the comparatively new means of using waste gas in gas engines. If gas engines were used they would get twice the amount of power, and although the first cost of establishing gas stations might be a little higher, the running cost and reliability were in favour of gas engines. He insisted that the surplus gases of that and other iron districts, if used as Mr. Merz had shown, could be made more valuable by developing power by gas engines.

Sir William White asked what was the greatest unit working by this power.

Mr. Westgarth replied that a gas engine of 5,000 H.P. was working at a San Francisco station, but the more cautious builders did not approve of going beyond 3,000 H.P.

M. Gouve also spoke in favour of the utilisation of waste gases by gas engine plant, which would ensure safe and continuous running without costing more for repairs, &c., than the average steam engine.

Mr. Selby Bigge said the whole crux of the question, whether one should supply oneself or purchase from a supply company, lay in the cost of the Board of Trade unit in each case. Each case must be treated individually. When in Westphalia and Silesia recently he had seen how large works were producing electricity, where they had valuable waste gases or any form of exhaust steam, at the rate of ¼d. per Board of Trade unit. From coal it was possible to produce, inclusive of interest and depreciation, at ·35d. to ·4d. per Board of Trade unit in large quantities. The power supply company came in most beneficially in the cases of new works and others not requiring more than 1,000 H.P.

Mr. Greiner (Seraing) approved of Mr. Merz's advocacy of co-operation between ironmaster and supply company. At Cockerill's works the electricity department sold the Board of Trade unit to other departments at ½d., and a third of this price was paid over to the blast furnaces for the supply of waste gases. The electricity department in this way made £10,000 profit. During periods of depression and at other times, they had too much electricity, and the question was what to do with the surplus. They would welcome such a power company as Mr. Merz had described, which would take over the surplus. With regard to gas plant, they had gas engines up to 11,000 H.P., driven by waste gas.

Col. Hawdon (Middlesbrough) said that gas engines, instead of steam, resulted in a saving of coal. It paid to put down a generating plant to use exhaust steam.

Mr. D. Carnegie (Sheffield) said that in Sheffield where there were many small works using from 100 up to 1,000 H.P., they were supplied at ·6d. per unit, with an increase of 5 per cent. when coal was 10 per cent. above 5s. 8d. per ton. They had just installed in Messrs. Osborn's works a motor for driving rolling mills, for they found it much more economical to have their works driven electrically than by steam power. He asked at what stage the user could introduce a separate installation into his works?

In replying to the discussion, Mr. Merz pointed out that it was impossible to get absolute coincidence between the supply of waste power and demand. At present they had only 15 per cent. waste heat, and the rest coal-fired stations, but it was probable that in that district next year half the energy sold would be produced by waste heat. He hoped that gas engines would be more used in that district, and his company would be glad to co-operate in putting them down in cases where they would pay, and would be prepared to take the spare electricity. In fact, if it was a question of taking energy from any waste heat plant, the more they could obtain the better. It was quite impossible to go into the question of cost of supply without knowing all the circumstances of the case and the load-factor. He considered that all works, whether on a small or big scale, could do better for themselves by co-operation with the power company than they could do separately.

The President (Sir Hugh Bell), in calling upon the meeting to thank Mr. Merz, pointed out that what had been said of gas engines was in favour of the system advocated by Mr. Merz. Now that electrical supply companies were covering not merely one or two parishes but two or three counties, the first thing that anybody ought to do when considering a new plant was to inquire what were the conditions of electricity in the district. It was a new position presented to the industrial world. The new manufacturer need not pay any more attention as to where he was going to take his supply from. Let him put down all his plant of the tension and type he desired. Then if he had any electricity to spare the supply company would buy it from him; if he wanted any additional power the company would supply it. So that the real question to be considered was one widely different from that which had faced them hitherto. It marked a new era. They on Teeside had already drawn benefit from the existence of such a company as Mr. Merz's. What an advantage this was to a busy district like theirs which was desirous of having new, smaller or subsidiary industries grouped round the larger industries which were characteristic of the district! They saw how the establishment of new works was encouraged and simplified.

A Strange Coincidence!—Our esteemed contemporary, the *Globe*, commenting last week on the breakdown at Lot's Road station (which it likens to "a gigantic Teddy bear lying on its back"), remarks that:—"It was a curious coincidence that about the same time a mishap occurred at the Kingston generating station, which caused a breakdown on the Kingston and Tooting tramcar route. It would be interesting to learn from some authority if these two accidents were caused by some electrical storm in the atmosphere, produced by the wonderfully hot weather which we have been enjoying. We understand so little really about electricity that disturbances may be going on around us of which we can perceive nothing, but which take effect at such centres as the electrical power stations." We can assure our contemporary that, in this instance, the storm was confined almost entirely to the interior of Lot's Road station, where for a time it raged with violence. But not everyone knows that the Kingston tramways are fed from Lot's Road.

REVIEWS.

The Calculus for Engineers. By Robert H. Smith. London: Charles Griffin & Co., Ltd. Price 7s. 6d. net.

This is another book that aims to teach the calculus by practical methods, and we must confess with regret that its object has not been attained. It is an alluring subject, this attacking the calculus by experiment, this jointing up of the integral with the differential and teaching the two together. It is alluring for the reason that the integral being the converse of the differential, it seems contrary to nature to take a separate text-book for each. If one be the other turned upside down, what can be easier than to assimilate both at the same time? But, alas! we must put with the word "alluring," in the case, its companion word "deceptive."

For instance, if it were thought necessary that a child should learn the alphabet backwards, it would be a mistaken policy to teach him when he was learning it forwards. For the mind of the child is then attacking a subject altogether new and pregnant with difficulty; and to imagine for one moment that because with trouble and tribulation he had learned his A B C in the usual way, he was then ripe for learning the C B A in the unusual way, would show a poor conception of his mental state. A hundred to one the attempt would end in utter failure, and would react on what he had already learned.

So also with mathematics. The converse is always more difficult than the direct, and very specially does this hold good for the calculus. If the integral be taken with the differential, the student simply gets into a maze; the wealth of symbols puzzles him; that difficult converse gets on his nerves, and at the best he finds he has no innate belief in what he is doing.

It is a pity to have to say these things, but truth will out, and we feel that we would not be serving the student's best interests by less than plain speaking. It is a pity, indeed, to have to say that a book of this kind, which evidences in the text painstaking care throughout its 200 odd pages, and which has attempted in several ways to give novelty to a difficult subject, should have failed in its particular object, namely, to make the path of the student in the calculus easy and rapid.

There seems one way only in which to tackle the calculus if a proper knowledge founded on consecutive proof is desired, and that is to study the differential first by the aid of a text-book that does not aim at demonstration, but states facts simply. When the differential is fairly well assimilated, the integral should be taken in a similar fashion. Of course, there are text-books *and* text-books, and a judicious choice should be made; not one of the old-fashioned kind, but one that takes examples that are of use, and employs plenty of squared paper.

At all costs avoid the book that professes practice, but talks theory.

The first few chapters deal with general ideas and principles. The author introduces a novelty in the shape of a capital X, for instead of writing in the ordinary way $y = f(x)$, he says $X = f(x)$. This is supposed to give clearness and want of ambiguity; but to the reviewer, the reverse seems to hold. For we have X, X′, X″, &c., and do what we will, the small x seems always in the way of the big one, and the mind seems to be always attempting, subconsciously, to differentiate their meanings.

The following is a sample of the text near this point. It will serve to show that the author is by no means clear in the language used, and that though his method of expressing things may be mathematically exact, he has not the gift of rendering a difficult subject easily intelligible to students:—

"X may mean a function which is capable of being also changed by changing the values of one or more other quantities besides x; but in so far as it is considered as a function of x, consideration of these other *possible* changes is eliminated by supposing them not to occur. This is legitimate, because these other elements which go to the building up of X, do not necessarily change with x. All elements involved in X, which necessarily change with x, are to be expressed in terms of x, and their variation is thus taken account of in calculating the variation of X."

This puts us in mind of the text-books of the fifties of last century.

In Chapter III we have "easy and familiar examples of integration and differentiation." Such things as the area of an expanding circle, a rectangular area, a triangular area, expanding pyramid, &c., are considered, but to the reviewer it seems that the method of attack is not enticing. It is to be noted, too, that the diagrams are mostly poor, and the lettering very often difficult to read.

"Important General Laws," including the commutative and distributive, are next considered.

Chapters on Particular Laws, Transformations and Reductions, Successive Differentiation and Multiple Integration, Independent Variables, Maxima and Minima, and Integration of Differential Equations, follow, and these bring Part I to a conclusion. Thereafter occur appendices on Time Rates, Energy Flux, Moments of Inertia and Bending Moments, Elimination of Small Remainders, Indicator Diagrams, Recurrent Harmonic and Exponential Functions, Successive Reduction Formulæ, Economic Proportions of I-Sections, Economic Design of Turbines, Commercial Economy and Indeterminate Forms.

Part II consists of classified reference tables of integrals and methods of integration, and this is by far the more useful portion of the book.

In conclusion, it may be stated that the work will have its place for those engineers who already thoroughly know the calculus (their number is limited, we fear). But its claims as a text-book for beginners are practically nil, and we should certainly advise no young student to touch it.

Telephones: Their Construction, Installation and Maintenance. By W. H. Radcliffe and H. C. Cushing, Jun. London: Crosby Lockwood & Son. Price 4s. 6d. net.

Although there is now a steadily growing mass of literature devoted to telephone practice, due, no doubt, to the marked impetus which that particular branch of applied science has received during the last decade, the authors in the preface to this book justify its existence by pointing out that their production is not intended to conflict in any way with other books, either of an encyclopædic character or of less pretentious design. It is intended, they say, for the amateur, the wireman, or the engineer, who desires to establish a system of communication on a small or fairly large scale.

No intricate mathematics are employed throughout the book, and no instrument or system is mentioned that is not fully described and illustrated, so that the book is a thoroughly practical one and of use in many directions; but it suffers from one serious drawback, as regards its value in this country, which is inherent from its origin. It deals solely with American practice, which, while being practically similar to English practice, for obvious reasons, as regard internal fittings and systems, is entirely at variance with the latter as regards the details of outdoor construction. As, however, it is in details that the differences occur, there should be no difficulty, should the book fall into the hands of English engineers, in adapting the principles laid down to our own particular methods; for a glance at any telephone line in this country during the perusal of the book under review, so as to enable a comparison to be made, will readily enable anyone to build telephone lines which will comply with all the requirements found to be necessary over here. Without drawing invidious comparisons, we should like to emphasise one or two of the principal details wherein the use of English methods seems to us to be somewhat in advance of those described in the book; for example, our method of arranging for the revolving of metallic loops around themselves and adjacent loops, tends rather more to efficiency than the transposition system described by the authors. The method of dealing with stays, too, differs entirely from that employed here; in fact, it might almost be said to be impracticable in many cases. But to point out the differences between the constructional methods described by Messrs. Radcliffe and Cushing and those accepted as standard practice in Great Britain, would almost necessitate the creation of yet another book. We therefore prefer merely to indicate that American methods are given and leave possible readers to judge for themselves, feeling that English engineers might

have their ideas broadened not inconsiderably by reading of methods, which experience under conditions other than those under which they are called upon to provide communication systems shows to be necessary.

We notice that the texts affixed to the two illustrations on page 51 have become interchanged, and we also notice two illustrations which might with advantage be reproduced upon all telephone users' cards of instructions, where such are in use, showing how to speak and how not to speak into a telephone.

On the whole, therefore, we are pleased with the book which, whilst not aiming at a very high ideal, certainly achieves its purpose; but we should like to say, however, that for the amount of matter which is published the price seems, in comparison with other literature which is available, to be rather high. Could this be reduced we feel sure that the book should command a ready sale.

BUSINESS NOTES.

Catalogues and Lists.—Messrs. Simplex Conduits, Ltd., London.—32-page catalogue of their conduits and fittings, in which price reductions are announced, though we understand that quality does not suffer in consequence. Some general particulars and a numerical index lead on to illustrations with tabulated sizes and prices of the several light and heavy-gauge conduits, the grip continuity system, sockets, bends, junction-boxes, and so forth, also tools for use by conduit wiremen. A new feature is the pricing of galvanised material. We learn that the company is making large extensions at its Garrison Lane Works and at its different branches. The company has also issued a 16-page illustrated catalogue of sundry switches, ceiling roses, wall sockets, lamp-holders, spider fittings, &c. It has also issued show-cards drawing attention to its Simplex metal-filament lamps.

British Insulated and Helsby Cables, Ltd, Prescot.—Six new illustrated leaflets have been issued dealing with the following manufactures:—Aluminium wire, strip and sheet; transformer fuse-boxes, terminal boxes, tramway section-boxes, demand indicators, and aluminium joints. Also pamphlet (P58) of twenty pages containing descriptions with illustrations of Prescot house fuse-boxes of the separate pole type for 250 and 500 volts.

The Expanded Metal Co., Ltd, Stranton Works, West Hartlepool.—Catalogue (Section No. 3) giving particulars of their expanded metal screens for switchboards, doors for high-tension cells, expanded metal covers for water starters, lamp guards, also guards for motor-driven machines. A list of electrical firms and works to whom the foregoing have been supplied appears at the end.

Gilbert Arc Lamp Co., Ltd., Chingford.—Eight-page pamphlet giving particulars, illustrations and prices of their flame lamps and enclosed arcs.

Premier Electric Control Co, Ltd., Premier Works, Red Lion Street, Clerkenwell, E.C.—New edition of their catalogue wherein are well arranged numerous views with descriptive and price particulars of their various starting and regulating apparatus, reversing controllers, ironclad switches and circuit-breakers, fuse-boxes and boards, and high-tension oil switches.

Mr. A. E. Mallandine, 51, Cheapside, London, E.C.—Show list particularising and pricing a number of draughtsmen's tools.

Mr. T. Scott Anderson, Royal Insurance Buildings, Sheffield.—Two small pocket pamphlets, one entitled "The Electrical Manufacture of Steel by the Anderson Patents," the other dealing with "Electrolytic Copper Recovery."

Edison & Swan United Electric Light Co., Ltd., 36 and 37, Queen Street, E.C.—Catalogue Section II (fourth edition) giving illustrations and prices of a number of electric fittings for ship, factory, colliery, street and traction service. The fittings are supplied with rubber rings, rendering them watertight as well as gas-tight. Some all-porcelain fittings are shown suitable for colliery, chemical and other work.

Messrs. Falk, Stadelmann & Co., Ltd., 83, 87, Farringdon Road, E.C.—This is a new and full catalogue of 112 pages wherein the firm has set out illustrations with prices of a large variety of electric light accessories. In addition to such lines as lampholders, multifarious switches, advertising signs, wires, conduits, and many other articles, they have now included some new lines, including arc lamps, motors, and water-tight fittings. The "Efes" code and a full numerical index occupy the last few pages of the book, which should be of use to the trade.

Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.—Two leaflets, one relating to glass shades for Osram and tantalum lamps; the other describing and illustrating the "Adjusto" patent universal joint window fitting.

Indestructible Cable Co., 47-51, Park St., Southwark, S.E.—Small pamphlet relating to the advantages of "Indestructible" wires and cables.

Brush Electrical Engineering Co., Ltd., Belvedere Road, S.E.—Leaflet giving information and prices of Brush incandescent lamps; also a folding pocket-card giving a list of branches and agencies.

Messrs. Peter Brotherhood, Ltd., 53, Parliament Street, S.W.—Illustrated pamphlet ("D") describing their fluid friction dynamometers for high and moderate speeds.

Crypto Electrical Co., 155 and 157, Bermondsey Street, S.E.—Publication giving details, prices, weights, &c., of single, two and three-phase Crypto A.C. motors.

Messrs. A. P. Lundberg & Sons, Liverpool Road, Islington, N.—Advance proof of a 10-page pamphlet wherein are described and illustrated in the firm's usual style, the latest types of the "Pivot combination," one of these being an improved type with recessed terminals. Various patterns of covers are shown, and a number of some of the latest examples of the firm's novelties which they are just ready to supply for the current season, are included. Particulars of the "Pixy" bell push which is also made for surface fixing are given.

Messrs. Johnson & Phillips, Ltd., Charlton.—Two new coded price lists, one of which deals with continuous-current dynamos and gives prices for shunt-wound and compound-wound machines for open, protected and totally enclosed types for 110, 220 and 440 volts. The other gives prices for alternating-current motors and starters. The A.C. motors listed are for two or three-phase, and the prices cover machines with wound rotors and also short-circuited rotors for pressures up to 550 volts. Both protected, ventilated enclosed, and totally enclosed types of machines are dealt with.

Private Meeting.—Charles Arthur Hemingway, trading as Hemingway & Pritt, electrical engineer, Eton Street, Richmond.—A meeting of the creditors of the above was held last week, when a statement of affairs, as at October 5th last was presented. This showed liabilities amounting to £2,603 19s., of which £488 16s. was due to trade creditors. There were also cash claims for £1,744, a bank overdraft of £306 and private creditors for £65. After allowing £56 for preference claims, the assets were expected to produce £787 11s., a deficiency being thus disclosed of £1,816. It was stated that the debtor started in business for himself in 1893, and traded alone up to 1901. He was then joined in partnership by a Mr. Pritt, who introduced fresh capital to the extent of £1,000. In September, 1906, the partnership was dissolved, Mr. Pritt retiring, but he did not take anything out of the business. The principal cash creditor was Mr. Pritt, the father of the debtor's late partner. It appeared that in all he had advanced a sum of £2,400, and when the partnership was dissolved he pressed for the repayment of the money. Eventually an arrangement was come to by which the claim was reduced to £1,500, which was allowed to remain in the business, interest being paid at the rate of 4 per cent. The interest had been regularly paid. The other cash creditor was a Mrs. Inglis, sister of the debtor, who advanced a sum of £200 at 4 per cent. interest. Between 1901 and 1906, there was a gross profit of £1,282, although in 1902 there was a loss of £350. The profits made during the period named was not sufficient to pay the partners' drawings. The debtor had no offer to make, and eventually it was decided to deal with the matter under a deed of assignment. The following were also appointed to act as a committee of inspection:—Mr. Whitford (General Electric Co.); Mr. Rooke (Sloan Electrical Co.); and Mr. E. H. Hawkins (Poppleton & Appleby). The principal creditors are:

General Electric Co.	£76	Siemens Bros. & Co.	£62
Berry, Skinner & Co.	68	Edison & Swan Co.	10
Sloan Electrical Co.	30	Harris, J. F. and G.	10
Faraday & Co.	20	Stearn Electrical Co.	30
Carter & Ainsley, Ltd.	25	Sun Electrical Co.	10
Simplex Conduit Co.	70	Young & Marten	10
Tucker, H., & Co.	30		

Trade Announcements.—With reference to the circular issued several months ago announcing the approaching conversion of their business into a limited liability company, Messrs. Schiff & Co. now state that from yesterday's date, the 15th inst., their firm is to be known as Ship Carbons, Ltd.

The General Electric Co., Ltd., announce that their Birmingham branch is now situate at 42, High Street, and extensive showrooms, containing all the latest designs in electrical fittings, heating and cooking apparatus, fans, plain and fancy lamps, glass and silk shades, &c., have been opened.

Owing to the large demand for "Tantalum" lamp show-cards issued by Messrs. Siemens Brothers Dynamo Works, Ltd., a reprint is now in course of preparation, and all applications will be filled at the earliest possible date.

Mr. G. T. Fairbrother, who was for some time in charge of the Cooper-Hewitt mercury vapour lamp, and has large experience in handling it, has joined Messrs. Ward & Cuningham, at Craven House, Kingsway, W.C., who are acting as distributing agents to the trade for these lamps.

Bankruptcy Proceedings.—W. T. Garnett.—The public examination took place at Bradford on October 7th. Details having previously been published in our columns. The debtor, in answer to questions, admitted that every business he had touched had been a failure. He estimated that he had lost £8,000 in the last 12 months from a fall in the price of copper. In the case of every business which he had conducted himself, he had had to rely upon the assistance of the bank. He had had a partner in the cable-making business, a Mr. Stell, who was to have 5 per cent. of the profits, but there were no profits. The reason which he had told the Official Receiver privately for the taking in of a partner in that business was the only reason. He had a cheque dishonoured in May, owing to his arrangement with the bank being that his overdrafts should not exceed £4,000. In reference to his transactions with Messrs. Johnson & Nephew, of Manchester, he sent out his manager to Scotland to get him some accounts, but even then could not get sufficient to pay them. That was why he deposited goods with them. Up to four years ago his household expenses were £2,500 a year. During the last four years they had only been £400 a year, his wife and son having maintained themselves in the South. In 1895 he would be worth about £50,000, but

he had since had disastrous experiences in a boot-lace business, a filter-making company, an Eastern export merchant's business, and eventually the cable business. The examination was closed.

Roller Bearings.—The Empire Roller Bearings Co., Ltd., has received an order for 1,216 wheels and roller bearings complete for India, and amongst other contracts recently secured are orders for roller bearings for the Ordnance Department and the Admiralty.

Norway.—The Nordiska Bolaget för Metalltradslampor is the name of a new company which has just been formed in Brussels, with a capital of £20,000, to manufacture electric lamps in Norway.

Book Notices.—*Gas Works Directory and Statistics for* 1908-9. London: Hazell, Watson & Viney, Ltd. 10s. 6d. net.—This is the thirty-first issue of this directory, and the material contained in it is revised to July, 1908. It forms a very useful index of gas-works in England and Wales, Scotland and Ireland, and also contains a foreign and colonial section. There is a general index of officials (chairmen, managers, engineers and secretaries) of gas lighting works, and lists of associations of managers and engineers.

"Transactions of the Glasgow Technical College Scientific Society." Vol. IV, Part 5, Electrical Hoisting Machinery, by J. Ritchie; Part 6, Feed Water Filtration and Purification, by A. E. Shute; Part 7, Application of Electricity to Pumping, by W. C. Mountain. Glasgow: The Technical College. Price 2s. each part.

"Proceedings of the American Institute of Electrical Engineers." October, 1908; Vol. XXVII, No. 10, Paper on High-Potential Underground Transmission, by P. Junkersfeld and E. O. Schweitzer. New York: The Institute. Price 50 c.

Dissolutions and Liquidations.—Multiphone Co., Ltd.—This company is winding up voluntarily with Mr. E. G. F. Medley, 6, Farringdon Avenue, E.C., as liquidator.

Charles A. Muller, electrical accessories merchant, 10, Arcade, Westgate, Bradford.—Messrs. Karl Oscar Müller and Carl Müller have dissolved partnership. Mr. Carl Müller will continue the business under the same style.

For Sale.—The extensive ground and buildings of the Scottish Cyanide Co., Ltd. (in liquidation), at Kirkland Works, Leven, Fife, are offered for sale by private treaty, as will be observed from an advertisement appearing in this issue.

LIGHTING and POWER NOTES.

Accrington.—A sum of £604 was the net revenue from electricity for 1907-8, and the number of units supplied for lighting and motors was 1,580,330, against 770,291 for the preceding year—more than double. The total number of units sold was 2 006 602, against 804,293 for 1906-7. The electric tramway commenced work in August, 1907, and though some months elapsed before the whole system was brought into use, there was an increased revenue from it of £10,820. The net revenue from the undertaking was £1,115.

Acton.—A conference was held on Friday last week between representatives of the U.D.C. and the Metropolitan Electric Supply Co. The company supplies the Council with energy in bulk, and the conference was held with regard to the fact that this arrangement has operated hardly upon Acton from a financial point of view. It is understood that on Friday a proposition was made on behalf of the company, and will be considered by the Committee of the Council which is in charge of the electrical undertaking.

Boyle (Co. Roscommon).—At a meeting of Boyle Rural Council on the 10th inst. the question of the lighting of the town, which had been in darkness for several nights previously, came up for discussion, and from this it appeared that the town was lighted by electricity for some years, but that this season it had fallen through owing to the fact that Mr. Hugh Stewart, the contractor, had not come to an arrangement with the Town Commissioners as to his payment for the three previous half-years. A resolution calling upon the L.G.B. to hold an inquiry into the matter, and asking for the views of the ratepayers concerned as to whether the lighting of the town should be taken from the Boyle Town Commissioners and transferred to the Council, was passed.

Braunton.—Messrs. Crompton & Co., of London, are interesting themselves in a scheme for the installation of electric light. A mutually satisfactory arrangement has been come to with the L. & S.W.R. Co., which will tend to lessen the cost, and if sufficient support is promised the scheme will be entered upon at once.

Brazil.—The Rio de Janeiro Light and Power Co., which has spent some 4 million pounds in electrical enterprises in connection with the City of Rio de Janeiro, for which it holds the sole concession from the Municipal Government of the Federal District, is now faced with unlooked-for competition, Messrs. Guinle & Co., a local firm, having induced the Federal Government to conclude a sort of contract enabling them to supply energy to the Central Railway at 20 reis per kw.-hour. The Federal Government appears to be acting independently of the municipal authority, with a view to compelling the Rio Co. to contest its rights. The latter company claims that it is at the present time supplying power at much lower rates than that mentioned.

Plans presented by Messrs. Guinle & Co. for an electric power transmission line for the purpose of conveying energy from the hydro-electric works on the river Itapanhau to Santos, State of Sao Paulo, have been approved.

Cardiff.—The town clerk has reported that the necessary powers required by the Corporation to wire consumers' premises and let out electric motors on the hire system can only be obtained by Act of Parliament, it being impossible to obtain them by provisional order. The matter has been referred to the Parliamentary Committee, with a view to a clause, or clauses, being inserted in the next Bill to be promoted in Parliament, empowering the Corporation to undertake the work.

Continental Notes.—Bosnia - Herzegovina.—Two hydro-electric schems on a large scale have been devised in Bosnia-Hersegovina. An artificial fall is to be created on the river Narenta, just above the village of Jablanica where the river makes a horseshoe bend, by the construction of a tunnel 2·1 km. long. The fall will have a height of 62 m., giving some 25,000 h.p. Application for a concession for this scheme is being made by a Dalmatian syndicate in Spalato. The other power station is projected at Lug, near Prozov, on the river Rama, a fall of 120 m., yielding 24,000 h.p., will be obtained by means of a tunnel 3·6 km. long. The concession for this is being sought by another Dalmatian syndicate, whose headquarters are at Zara. A portion of the power obtained from the Narenta fall will be used for the electrification of the Sarajevo-Mostar-Metkovic railway; the remainder of the energy will be available for industrial undertakings and other applications. Jablanica lies about 40 km. from Mostar and 80 km. from Sarajevo.

Germany.—The municipal central electric lighting station in Zittau, Saxony, is about to be extended at an estimated cost of £13,500.

Large central electricity works are to be built at Weissensee, Silesia, to supply the surrounding industrial district.

It is proposed to expend £70,500 on the extension of the Posen municipal electricity supply works.

Italy.—Engineer Nitti has arranged terms with the Government Commissioners of Vetralia to erect and set to work an electric generating station for the town and neighbourhood. The work is to be commenced at once and pushed through to completion as rapidly as possible.

Russia.—St. Petersburg.—The electricity supply companies in the Russian capital, which are administered from Berlin, have combined as a syndicate for the raising of the charges for lighting and power purposes. As a consequence, the University, the Berg Institute, and a number of public establishments, whose contracts with the Helios and other companies will shortly expire, are considering the question of laying down generating plant of their own.

Crumlin.—Messrs. Partridge, Jones & Co. are sinking and equipping new collieries at Crumlin, which will have an estimated output of 18,000 tons of coal per week. Electricity will be used for various subsidiary work; two 750-b.h.p. engines and generators being installed for motor driving, and two 70-b.h.p. sets for lighting. The whole of the electrical equipment has been entrusted to Messrs. R. Alger & Sons, of Newport.

Dublin.—A special meeting of the Corporation was held on the 12th inst. for the purpose of considering reports from the Lighting Committee. On the motion of Mr. Altman, seconded by Mr. Doyle, the recommendation of the Committee that Messrs. Babcock & Wilcox's tender to supply the boiler, plant and accessories at £6,432 be accepted, was adopted. A further recommendation *re* the extension of the public electrical lighting was referred back to the Committee for amendment in some respects.

The Castle—parts of which date from the thirteenth century—is being modernised in several ways. A large staff of workmen are engaged in carrying out various improvements, and these include the extension of the electric lighting, which is to be established in every department of this huge building—which is the headquarters of the Irish Government—and the installation of an electrical lift for the purpose of transporting luggage. These improvements are to be completed before the Castle season opens.

Fintona (Co. Tyrone).—This town is interested in an electric lighting scheme, and the Town Committee is in communication with firms on the subject, on the basis of a substantial guarantee. The motive power can be easily supplied by the river—one of the tributories of the Mourne—which flows through the town.

Felixstowe.—The Council has decided to offer the company £8,000 for its interests in the electrical undertaking, excluding certain gas plant, &c., the offer depending on acceptance in 14 days, completion of contract in 28 days, and L.G.B. sanction to the necessary loan before February, 1909. The above offer was decided on after receiving the report of Mr. R. P. Wilson on the probable cost of the Council's proposed new plant. The figures given in this connection were: Steam (outfall site), £7,895; steam (town site), £6,310; and Diesel plant (present site), £4,225. Plans and specifications are to be got out for whichever scheme is decided on, and tenders are to be obtained.

Frimley.—At a meeting of the U.D.C. on October 6th, a letter was read from the general manager and secretary of the Aldershot Gas and Water Co., stating that application was being made to the B. of T. for powers to supply electricity in certain districts, including the area named in the Camberley E.L. Order

1906, the revocation of which was now under consideration by the B. of T. The support of the Council was solicited. The Council referred the matter to a Committee.

Glasgow.—The engineer of the electricity department has been instructed to make a statement showing the sum required to meet capital expenditure in the near future, the treasurer having reported that the unexhausted borrowing powers of the electricity department as at this date amount to only £50,000, that the amount which the Corporation had obtained authority to borrow was £1,850,000, and that it will be necessary to make application to the Secretary for Scotland for consent to borrow a further sum of £150,000.

A special sub-committee of the T.C. has been asked to report upon the proposed extension of the Port Dundas power station, a plan and report in connection with which has been prepared and submitted by the engineer.

From the annual report of the Glenboig Union Fire Clay Co. it appears that £4,928 was expended in payment for the first portion of the electric power plant already installed, the practical working of which had satisfied the directors that the company would fully reap all the benefits anticipated by the change from steam to electric power. The complete installation will be accomplished during the current year.

Hereford.—With a view to inducing consumers to use electricity for lighting during dark days, the T.C. has adopted the two-rate meter system, by which current will be supplied at power rates between midnight and 5 p.m. for the December and March quarters, and between midnight and 8 p.m. for the June and September quarters.

Hove.—A resumed B. of T. inquiry into the application of the Corporation for a reduction in the price charged for electricity for lighting by the Hove Electric Lighting Co., was held on October 8th. The inquiry was closed, and the inspector will report to the Board in due course.

Liverpool.—The subject of the four turbines supplied by the Westinghouse Co. for the Lister Drive electricity generating station was again discussed at length at the T.C. meeting on October 7th, on the presentation of the consulting electrical engineer's report. Sir Wm. Bowring described the report as "whitewashing," and said that tests had been made of the turbines, and these had been reported upon as satisfactory. Yet, notwithstanding, they found that the machines had been perpetually under repair, and had even been reconstructed. Why, he asked, was all this expense on alterations disguised from the public? He contended that Liverpool had the dearest electrical installation in the kingdom. The position of the Committee and of the electrical engineer was vindicated by Sir Charles Petrie, who declared that there had never been anything to conceal, and that the turbines had worked quite satisfactorily. Sir Wm. Bowring's amendment to refer back the report was defeated by 60 votes to 19—an emphatic endorsement of other decisive votes of the Council on the same subject.

London.—L.C.C.—The Finance Committee, reporting at Tuesday's meeting of the L.C.C., stated that the Battersea B.C. had applied for a revision of the period (20 years) of its loans for mains and house services, by the substitution of the new terms now allowed by the County Council of 30 and 12 years respectively. Unlike other boroughs, Battersea adopted an arrangement for 50 years and 20 years for different parts of the undertaking. The Battersea B.C. was repaying all its loans on the instalment system, thus reducing the debt more rapidly than those undertakings which had adopted the annuity method. The net result of the proposal, if given effect to, would be a reduction in the loan repayments of about £1,400 a year. The Committee submitted a recommendation to give effect to the desired variations, setting forth the loans in detail.

City.—Mr. Adrian Collins is to be consulted by the City of London Guardians, with a view to reducing the cost of electric lighting in the infirmary and workhouse.

Shoreditch.—The President of the Board of Trade is to be asked to receive a deputation from a conference of local authorities convened by the B.C., who desire similar powers to be given to local authorities for linking up their undertakings as those proposed to be conferred on companies by the London Electric Supply (Companies) Bill. Each local authority within the area of the Bill is to be asked to appoint two delegates to the deputation.

Loughborough.—The T.C. has agreed to secure the services of an expert to advise on the general management and finances of the electricity undertaking.

Lowestoft.—The T.C. has decided to light sundry streets in the borough with electricity in place of gas. This will result in 19 gas lamps being replaced by 27 electric lamps. The estimated cost is £3 per lamp per annum.

Marlow.—At the last meeting of the Urban Council an application was received from Messrs. Wethered, the well-known brewers of that town, for permission to lay electric light cables. The matter was referred to a committee of the whole Council.

Pembroke.—At the weekly meeting of the U.D.C. the draft mortgage for a loan of £6,000 to carry out the electric lighting was read, and it was decided to complete the mortgage as soon as possible.

Ramsbottom.—The local U.D.C. has given the Lancashire Electric Power Co. permission to supply electricity to the Cuba Mill Co. at Stubbins, near Ramsbottom, upon certain conditions.

Rhyl.—At a meeting of the U.D.C. on Monday, a letter was read from the Llandudno and District Light Railway Co., asking if the Council would meet to discuss terms as to providing Rhyl with a tramway. It was agreed to go into the matter.

Middlesbrough.—The T.C. has decided to introduce electric lighting along the principal thoroughfares.

Motherwell.—In quoting a report last week on the low average price obtained at Greenock for electricity, we inadvertently slighted Motherwell, which claims to sell at 1·30d., as against 1·62d. per unit at Greenock, and, moreover, generates at ·65d., as against the ·92d. of its neighbour.

Sheffield.—A L.G.B. inquiry was held on October 7th into the Corporation's proposal to borrow £120,000 for various municipal projects, including £11,000 for electricity purposes. Opposition was offered by the traders in electrical fittings, and a legal fight as to the right of the Corporation to sell wires and fittings was foreshadowed.

South Africa.—The Germiston T.C. is recommended to extend the present lighting contract with the Victoria Falls Power Co. for 12 months from September, 1908. Tenders are to be invited up to December, for a supply in bulk to the municipality, and it is intended to raise £20,000 to carry out the work in the event of a tender being accepted, and £40,000 if the Council establishes its own scheme.

Victoria Falls Power Co.—News has been received to the effect that the new 6,000-kw. station at Brakpan has started work, and is supplying power to a number of mines.

A fatal boiler explosion occurred at the Cape Town power station of the Cape Government Railways on September 17th, by which a fireman lost his life, and a cleaner and switchboard attendant were seriously injured. There were eight men on shift at the time, and it was very fortunate that there were no more casualties, as portions of the buildings were wrecked and windows broken over a large area, besides portions of the *débris* being scattered for half a mile. The steam pressure was 150 lb. per sq. in. A Government inquiry will be held shortly.

Straits Settlements.—The Government has sanctioned the proposal of the Penang Municipal Commissioners to raise a loan of 100,000 dollars, for the extension of the electric lighting and the duplication of the electric generating plant in the Northern Settlement.

Tonbridge.—The U.D.C. has received from the L.G.B. sanction to a loan of £3,053 for excess expenditure, new plant and prospective expenditure on mains; to a loan of £150 for house services; and to a loan of £150 for meters.

Warrington.—The T.C. has adopted the following scale of discounts to consumers:—Lighting, from 1s. 2d. in the pound for below 120 units per quarter to 2s. 2d. between 9,000 and 12,149 units. Power, from 1s. in the pound for between 2,500 and 3,749 units per quarter to 2s. 6d. for between 205,000 and 234,999 units.

West Ham.—The borough treasurer's report on the electricity accounts for the past financial year has been submitted. He said he did not propose to reply further to the statement of the electrical engineer that the deficiency for the year was in some way attributable to lack of information in the treasurer's department. The deficit was simply due to the disparity between the costs and charges.

The annual report of the electrical engineer and manager set forth that there was an increase in revenue of £9,745. Against this, however, the expenditure had gone up by £12,586. A portion of the increase under the latter head was due to the higher price of coal and the increased output. The major portion of the increase in revenue was owing to the greater amount of energy sold for power (£6,660). He (Mr. Seabrook) was aware that it had been stated that the losses of the undertaking were greater than in the previous year (when the loss was £1,829) because they had been supplying power below cost price. He contended, however, that the charges were correctly calculated and applied, and he was sure the Committee would feel more confident on this point when it had received the report now being prepared by Mr. Arthur Wright.

Windsor.—The Board of Guardians is still being urged to adopt electricity for lighting and power purposes at the workhouse. At the last meeting of this authority it was stated that if electricity were installed, it would mean a saving in the lighting bill of over £40 per year, and if the energy were used for pumping water £164 per annum would be saved in that respect.

Worcester.—At a meeting of the T.C. on October 6th, it was reported that the plant at the Powick generating station had been disposed of to Messrs. Thos. Ward & Co., of Sheffield, for £850. It was originally estimated that £1,650 would be realised, but the low price obtained was owing to the fall in the price of copper from £110 to £56 per ton.

Flame arc lamps of a total of 32,000 c.p. are to be installed at the Butter Market.

TRAMWAY and RAILWAY NOTES.

Burnley.—The London Electrobus Co. has applied to the Tramway Committee for a licence to open a service of electric omnibuses in the borough, where no electric tramway service is afforded. A recommendation has been made that in the event of the application being acceded to, traffic should be confined to strictly suburban routes, and the town clerk has informed the company of the Corporation's powers to run and work motor-omnibuses.

Continental Notes.—Italy.—The Government has provided a credit of 70 million lire for the establishment of electric traction on several lines where there are heavy gradients and long tunnels. The following table gives the names of the lines and the length in km. The second column represents the cost in millions of lire estimated for the necessary work on the permanent way, the balance being the estimated expenditure for locomotives and accessories:—

Lines.	Length in km.	Cost in millions of lire.
Bardonecchia-Modane	22	3·7
Domodossola-Iselle	18	2·4
Gallarate-Arona	26	2·2
Gallarate-Laveno	32	2·6
Milano-Lecco	51	3·6
Usmate-Bergamo	26	0·5
Calolzio-San Pietro	19	2·2
Savona-San Giuseppe	21	2·5
Pontedecimo-Bussola	11	4·3
Galleria-Genova	4	1·0
Pistoia-Porretta	40	3·0
Napoli-Salerno	54 }	5·0
Torreano-Castellamare	6 }	

The Government has also granted a concession to a company of Italian, Belgian, and French capitalists to construct a high-speed electric railway between Rome and Naples, the length being about 200 km., and the journey to be done in two hours; the existing line is 250 km., and the journey occupies five hours.

The provincial authority of Lucca has been asked to grant a concession for constructing and working an electric tramway from the town to the Tovie, to Maggiano, and to Santa Maria del Guidice. This last line will traverse a very thickly populated district, and will probably be extended to Bagni, and subsequently to Pisa. The overhead system is to be adopted, and the cars will be of the same type as in Milan, with 34 seats; the necessary energy will be provided from the hydro-electrical works which are now under construction at Serchio.

The construction of the railway between the towns of Genoa and Bersalla has been commenced, and when completed the line will greatly facilitate the heavy traffic from the port of Genoa. The whole of the machinery and the buildings are so far advanced, that unless unforeseen difficulties arise, it is hoped the line will be opened early next year.

Austria.—The Austrian Ministry of Railways will shortly be able to submit definite projects for the electrification of the Alpine railways, as the engineers of the Railway Administration have as good as finished their labours. Four leading projects engaged attention. The lines to be electrified will be first the Attnang-Selzthal, which will serve as an experimental line; the Vorarlberg will then come under consideration, principally on account of its international importance, as well as to dispose of the burdensome smoke question. The two lines to follow will be the Trieste-Optschina and the Vintschgau railways.

Russia.—According to the *Russ* a congress was held at the end of September in St. Petersburg of the heads of the Railway Administrations, with the object of considering the introduction of electric working on the following lines:—Moscow-Charkov, Sebastopol-St. Petersburg, Warsaw-St. Petersburg, and on the lines of the following cities:—St. Petersburg, Wilna, Kiev and Odessa.

Croydon.—The B.C. on Monday evening authorised the doubling of another small length of track in High Street to minimise, as far as possible, the delays occasioned by the narrowness of the thoroughfare. The estimated cost of the work is £616. For the three weeks ended September 25th, 1,029,638 passengers were carried, an increase of 67,499 on the corresponding period of last year, the receipts being £4,639, as compared with £4,275.

Folkestone.—At a meeting of the T.C. on October 7th, the Mayor hinted that the National Electric Construction Co. would in all probability write to the Council in a few days suggesting that the overhead system should be substituted for the surface-contact system for the proposed tramways. It will be remembered that the Earl of Radnor, who owns the greater part of Folkestone, is opposed to the use of overhead wires. The company has asked Hythe T.C. to acquiesce in the use of overhead wires, but the Council has deferred decision in order to ascertain what Folkestone T.C. will do in the matter.

Gateshead.—At a meeting of the T.C. on the 7th inst., considerable correspondence was reported to have passed between the Town Improvement Committee and the Gateshead and District Tramways Co., with reference to proposed alterations and extensions on the system. The Committee reported that it was prepared to recommend the Council to agree to the proposed application by the tramway company to Parliament in the ensuing session, to postpone the date for the exercise by the Corporation of its powers of compulsory purchase of the company's undertaking until August, 1927, subject to the company extending and doubling certain routes, paying a contribution to certain widenings, and arranging the alteration of the wagon way at Wrekenton. On behalf of the company, a reply had been received suggesting that the date of the exercise by the Corporation of its powers of compulsory purchase be postponed for 10 years, viz., until August, 1932. To this the town clerk had replied that the Town Improvement Committee was prepared to recommend the Council to agree to a period of eight years, from August 12th, 1922, as the extension period before compulsory purchase. After discussion the report was adopted.

Greenock.—In connection with the new torpedo factory, a proposal is on foot to construct an additional tramway which would serve the working-class districts and a large area at present unprovided with traffic facilities.

Hanwell.—The Commissioner of the Metropolitan Police has forwarded to the U.D.C. the report of the local Inspector on the condition of the tramway track in Hanwell, in which he states that almost invariably it has been found that the noise is due rather to the condition of the track than to that of the cars. The Commissioner adds that he has no control over the condition of the track. The Council has decided to ask the B. of T. to intervene.

Hove.—The T.C. has invited the London Electrobus Co. to renew its application to open a service of 'buses in the town in three months' time. The local Omnibus Co. is converting its petrol vehicles for electrical working, and is negotiating for the purchase of three more electrical 'buses.

Hythe.—At the monthly meeting of the T.C., an intimation was received from the agents of the Folkestone, Sandgate and Hythe Tramways Co. that it intended to apply for Parliamentary powers to amend its Act of 1906, and to substitute the overhead system for the Dolter surface-contact system then proposed. A long discussion took place on the matter, it being feared evidently that the company might isolate Hythe unless a conciliatory attitude were adopted, and in the end the matter was deferred for a week pending inquiries by the town clerk as to the position of the other authorities concerned.

Lincoln.—A proposal has been considered by the Electricity Committee for extending the tramways to the eastern and western portions of the city, at an estimated cost of £24,000. The matter is to come before the Council for consideration.

Liverpool.—In dealing with a proposal before the City Council on Wednesday last for a new tramway route to Broad Green Road, Liverpool, Sir Charles Petrie (Chairman of the Electricity and Tramways Committee) said the Committee thought it might be possible to run cars there by means of the trackless trolley system, and had the question under consideration.

London.—A fire occurred last evening at the County of London Electric Supply Co.'s generating station, Oak Wharf, City Road, causing damage to a switchboard and a portion of the roof of the engine room. A workman named Frederick Collings was also slightly burnt. Some inconvenience was caused to consumers.

New South Wales.—The construction of a tramway from Broadmeadows to Waratah, Newcastle, is being urged, the estimated cost being £15,800; the proposal is to be submitted to the Cabinet.

Taunton.—At a meeting on Tuesday of the T.C., five petitions were presented, signed by a large number of the ratepayers and residents along the line of route of the tramways, complaining of the excessive noise caused by the cars, and asking the Council to take steps to compel the company to run the cars more quietly, as the present noise was seriously detrimental to business. A proposal to apply for an injunction against the company was rejected by 11 votes to 6 in favour of steps being taken to obtain expert evidence as to the state of the tramcars and track.

Victoria.—Last October the Government invited Mr. C. H. Merz to Melbourne with a view to his reporting on the advisability of electrifying the State-owned suburban railways, which are at present steam-operated. Mr. Merz's report was received by this week's English mail; its main features have already been made public. The Premier has stated that the report is such that he does not see any course open to the Government but to proceed with the electrification of the first stage of 29 miles; and there is scarcely any doubt that Parliament will sanction the work. The estimated expenditure for this first stage with necessary power station and sub-stations is set down by Mr. Merz at £801,880, made up of the following items:—Electrification of Port Melbourne, St. Kilda, Sandringham and Broadmeadows railways. Route length, 29 miles:—

Power station, high-tension feeders and sub-stations, including spares for power department	£386,357
Track equipment, including low-tension cables and alterations to permanent way and spares	170,328
New rolling stock (less credits), alterations to existing stock and electrical equipments, including spares	221,657
Inspection pits and car-shed	23,538
	£801,880

Walsall.—The drivers on the Bloxwich section of the tramways have presented a petition to the Tramways Committee stating that a little more time is necessary for the running to be carried out satisfactorily to the Committee, the public and them-

selves, and that "the present running will tend in time to break their constitutions." The manager having reported that to increase the time allowance an extra car would have to be brought into service at a cost of £104 per annum in wages alone, which would reduce the saving effected in working by reason of the construction of the double lines, the Committee has instructed the manager to inform the drivers that it is unable to increase the time allowance.

Whickham.—At a meeting of the Urban Council on the 8th inst., the Committee appointed to consider the establishment of a tramway service, reported that Mr. William Morrison, manager of the Gateshead and District Tramways Co., had attended a meeting of the Committee, when the chairman explained the urgent need for such a service throughout the district, and especially the extension of the tramways from the Bensham terminus, Gateshead, so as to tap Marley Hill and district, and from the Cross Keys, Dunston, on to the main road at Swalwell. The Council, in accordance with Mr. Morrison's suggestion, decided that plans should be got out for the two schemes, and forwarded to the tramway company, with a request that the directors should meet the Committee on the spot, and discuss matters.

Wolverhampton.—The Tramways Committee has now decided to extend the Lorain system of traction to the Lea Road and Penn Fields district, where a motor-omnibus service has been in existence for some time. That this service was popular the following figures verify:—

Passengers carried for 12 months ended March 31st, 1908	538,766
Receipts per car-mile	10·896d.
Miles run	56,923

It is anticipated that a tramway service will ensure increased receipts due to a quicker and more reliable service, which will also convey passengers to the centre of the town.

It is proposed that the line throughout should be a single one with turnouts, and the cost is approximately estimated as follows:—

Permanent way	£12,730
Electrical equipment	3,990
Main feeder cables	1,920
Rolling stock: three cars	1,950
	£20,590

The Committee has been instructed to invite tenders for the construction of the permanent way and the electrical equipment thereof.

TELEGRAPH and TELEPHONE NOTES.

Ceylon.—The *Ceylon Observer* understands that on the estimates for 1908-9 will be found a sum of no less than two lacs of rupees for the extension, by trunk lines, of the present telephone system to Kandy and Nuwara Eliya, and for the reconstruction of the Colombo system, by relaying the wires underground in accordance with Mr. Arthur Preece's recommendations.

German Cable.—It is announced from Emden that the work of laying the new cable to South America has been commenced. The first section, which will extend from Emden *vid* Borkum to Teneriffe, will be 2,163 nautical miles in length. The cable will then be continued from Teneriffe, either direct to Pernambuco, in Brazil, or to Mouravia, in Liberia, first, and thence to Pernambuco. The length for the direct route from Teneriffe to Pernambuco would be 2,766 n.m., whereas the alternative route would increase the length to about 3,766 n.m. It is considered that notwithstanding the greater cost of the latter scheme, it would prove to be more remunerative owing to the prospect of the cable being extended to the German colonies in West Africa.

The Blätter für Post und Telegraphie, in making reference to the recently formed German South American Telegraph Co., emphasises that the German Colonies of Cameroon and German South-West Africa can at present only be reached telegraphically by British lines, and that the British and French also possess a cable system to Brazil. There is no doubt that the German nation is keenly alive to the necessity of providing as far as possible a national system of cables, and that it is shirking no expense to attain it.

Holland.—The telegraph system during the year 1906 attained a total of 7,054 km. of line, and 33,340 km. of wire; 3,526 and 1,760 metres of underground line were laid in iron and asphalt conducts respectively, while underground cables attained a length of 278,828 metres; and sub-river and marine cables, 250,935 metres. The increase in the latter figures is 30,723 and 11,477 respectively. Interruptions of the service numbered 4,864, as against 5,010 in 1905. The offices totalled 1,241, being an increase over 1905 of 29. Of these the State owned 273 telegraph and 614 telephone offices, and 7 semaphonic stations, and 347 were owned by private interests. There were in use 677 Morse, 143 Hughes, 4 Baudot, and 446 speaking instruments. The Inland traffic decreased by 1·2 per cent. in comparison with the previous year, and totalled 3,072,166 telegrams. The average number of words per telegram was 14·70. The International traffic amounted to 3,190,042 telegrams, an increase of 3·8 per cent. over 1905; 2,687,225 were for European countries, 214,809 for extra-European countries, while 288,008 passed in transit. The greatest number of telegrams, viz., 964,600, was exchanged with Germany, Great Britain following with 786,173, Belgium with 393,872, and France with 198,233. The Dutch Indies accounted for 41,428 telegrams, and the United States for 154,565, the increase over 1905 being 10 per cent. The Anglo-American Cable Co. forwarded 73·9 per cent. of this traffic, the French-American route 4 per cent., and the German-American route 21 per cent. The figures for the wireless telegraph service are interesting; 475 radio-telegrams were dispatched to inland places, and 1,859 to International places, while the numbers of messages received were 54 and 24 respectively. Service messages numbered 55, and messages exchanged between stations 13, making a grand total of 2,480 messages.—*Journal Télégraphique.*

Paris.—It was recently reported from Berlin that German firms would participate in the work of reconstructing the burnt-out telephone exchange in Paris. The name of the Bergmann Electricity Co., of Berlin, is specially mentioned in this connection, through the intermediary of its Paris factory—the Société Anonyme des Usines Electriques Bergmann—which is negotiating for the supply of insulating tubes to the authorities. It is stated that this company effected a similar delivery after the fire on the Paris Metropolitan Railway a few years ago.

St. Petersburg.—It is announced that the municipal Council proposes to devote the sum of £300,000 to the purpose of extending the telephone network. The money is to be provided for in the next city loan.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Port Arthur-Chifu	Mar. 9, 1904 ..	..
Assab-Massouah	June 28, 1908 ..	..
Sitia-Rhodes	Sept. 20, 1908 ..	Oct. 6, 1908

Telephone Employés.—The Postmaster-General at Sheffield, on Thursday last week, referred to the statements as to the discharge of men by the National Telephone Co., and said that the Government was inquiring into the matter, which, he thought, had been greatly exaggerated, and was considering how far it was possible to take into the employment of the Post Office any men whom the National Telephone Co. might part with.

Telephone Rates.—The Liverpool Chamber of Commerce has resolved that Mr. Charles Lancaster be reappointed as a representative of the Liverpool Chamber on the Telephone Committee of the Association of Chambers of Commerce of the United Kingdom. In the course of a discussion, says the *Liverpool Daily Post*, reference was made to the action of the Telephone Committee itself in refusing to summon to the meetings Mr. Lancaster and Mr. Faithful Begg, of the London Chamber, on the ground that they were shareholders in the Telephone Co. Several members said that they were fully aware that Mr. Lancaster was a shareholder in the company, but they were also satisfied that he was the best member of the Chamber to represent them on that subject, as he had made a thorough study of the matter. It was pointed out that the changes proposed by Mr. Lancaster, if adopted, would mean a loss to the Telephone Co. of £300,000 a year.

Telephone Rental.—At Manchester last week the National Telephone Co., Ltd., sued the Manchester Tivoli Theatre Co., Ltd., for £5, the rent of a private wire from the theatre to a fire station. It was shown that the fire station had been removed, and as the defendants refused to pay mileage for the extension to the new site, the wire became ineffective. Judge Parry gave judgment for the defendants on the claim, with costs, and also on a counter-claim for rental paid for the period after the wire was disconnected. Leave to appeal was given.

Turkey.—The Turkish Government has announced that international tenders will be invited for the establishment of a telephone service, and the monopoly will be given to the tenderer offering the most advantageous terms.

Wireless Telegraphy.—A correspondent of the New York *Tribune* reports that a record in wireless telegraphy was achieved on the 11th inst., when, for a space of two hours, uninterrupted communication was maintained between the wireless telegraph stations at San Francisco and Honolulu, a distance of 2,100 miles.

Contracting at Nelson.—At Nelson Town Council on October 8th, a letter was read from the secretary of the Burnley and District Electrical Engineers' (Employers') Association, asking that all electrical engineers executing work in Nelson be authorised on definite lines, as in the case of plumbers for gas and water work. It was resolved, however, that the letter lie on the table.

Football.—At Burton, last week, a First League football match was played by the light of 10 of the Electrical Company's 10-ampere flame arc lamps, four being used on either side of the ground, and one at each end over the goals. Mr. P. J. Pringle's department carried out the arrangements. The arc lamps were run in series directly off the trolley wires at 520 volts. The grand stand was illuminated by five 50-c.p. Osram lamps.

SUPPLEMENT.

WIRE LAMPS.

By JAMES SWINBURNE, M.Inst.C.E., F.R.S.

It looks at first as if the modern wire lamp was the result of some sort of atavism, as the early workers, especially Edison, experimented a great deal on platinum. About 30 years ago, when people were trying to solve the problem known as the "Sub-division of the Electric Light," Edison, who had a complete understanding of what was necessary for parallel distribution, was working away at the hopeless task of making incandescent lamps of platinum. Then Swan came along with carbon, which, as a matter of fact, had been suggested as long ago as 1836, and everybody, that is to say, the small number of people working at this problem, turned their whole energies to the making of carbon filaments. Since this it has been almost taken for granted that carbon was the only possible material for lamp filaments. It has high specific resistance. Thanks to the use of homogeneous cellulose, due to Swan, and the methods of squirting, also due to Swan, the filaments can be made very thin and uniform.

But in spite of the universal use of carbon in practice, attempts were made at intervals to use other materials. Silicon and boron attracted many experimenters, and all sorts of processes were devised for depositing silicon as a sort of skin over the carbon. The chloride of silicon is volatile, and one idea was to heat the carbon electrically in an attenuated atmosphere of hydrogen and silicon chloride, so as to get the silicon down, the chlorine combining with the hydrogen. Langhans worked in this direction, and produced filaments which were about half silicon. Whether he produced them exactly in this way, I do not know.

It is a little difficult to understand why people did not try such elements as tungsten. Probably they were discouraged by the nature of the metal. It was known to be very difficult to fuse, and it seemed an insoluble problem.

About 10 years ago, however, Welsbach, who had already helped the gas industry by the invention of the incandescent mantle, succeeded in making short wires of osmium. The osmium lamp was for a long time available only for very low pressures, but the melting point is so high that a very high efficiency is obtained. Owing to the fragile nature of the wire and the low specific resistance, the osmium lamp had little application except in special cases where low pressures were available from batteries. But the osmium lamp undoubtedly turned people's attention to the possibility of wire lamps. Osmium is a rare metal, and there might have been difficulty in getting enough of it. I do not know how far the scarcity is real, and how far it depends only on the smallness of the demand.

The next lamp to attract attention was the Nernst, which came out almost at the same time as the Welsbach. This lamp gave a very good efficiency; but it had many drawbacks, as it needed a series resistance or ballast, like an arc lamp, and a heater, which had to be cut out of circuit by an automatic arrangement as soon as the lamp was lighted. The future of the Nernst lamp seemed very promising at the time of its inception, but it is doubtful if it can hold its ground against wire lamps.

The next was the tantalum lamp. This contains a simple wire of tantalum, which appears to be drawn like copper. The methods of manufacture have not been published; the wire may, therefore, be drawn in the ordinary way, or it may be made by the Wollaston method—that is to say, by drawing a compound wire with a tantalum centre, and then dissolving the outside wire.

For a long time the tantalum lamp was recommended for direct currents only. On alternating circuits the wire broke in a very extraordinary way. A wire that had been in use for some time was all bent about in a very strange manner. Through a microscope it looked as if it were made up of numbers of little short cylinders stuck together with their centres out of line. It is difficult to imagine how such a state can be reached. It seems possible that the metal is near its melting point, and that it is small enough to be able to follow the waves, especially if the frequency is low. It may be possible that the wire melts at a given point, but cools again before a complete rupture has been made. A sort of shear increases the radiating surface, so that it is not likely to melt there again. Whatever is the real reason, the makers claim to have overcome the difficulty, and to be able to make lamps for alternating as well as for direct circuits.

Tungsten is the favourite metal for lamps now. Who was the first and true inventor will very likely be a complicated question that the law will decide in an expensive way in due course, so I will not discuss it. There are several ways of making tungsten wires; or, at least, there are several published methods, but which will really work and which are only ornaments or patent literature, I cannot say without trying them.

One method is to make the metal into a very fine powder by making an arc between tungsten electrodes under water. Bredig made very fine colloidal platinum in this way, and the method is used for making a paste of tungsten. This paste is then squirted through a nozzle, and the resulting filaments are baked and then heated electrically *in vacuo* to get rid of any carbon from the agglutinant, if that has been used, and to unite the particles of metal together. Several of these wires are mounted in series to make a 100-volt lamp. Another method is to use a volatile salt of tungsten, and to deposit it on an electrically heated filament of carbon, which is then volatilised, leaving the tungsten.

There is another possible method of making very finely divided metal for paste, and that is to use the metal as cathode in a solution with a very high current density. The metal is then torn off the cathode in a very fine powder. This phenomenon has been very little investigated. For my part, I came across it by chance. I was giving an afternoon lecture at the Royal Institution, and wanted to show copper dissolving in acid in a lantern, and I used a large current to make it go quickly. An opaque stream came from one electrode, and going up to the lantern I found it was red; so I stopped the experiment as quickly as I could, and examined it afterwards. I found the red stream had come from the cathode. I did not discover this phenomenon, it was known before, but it is not well known even now. It has

been said that this is the same as the Bredig process: it is not, as I understand it; for in the Bredig process the powder comes from the anode, in this process it comes from the cathode.

Whether some of the other metals will come into use and replace tungsten is uncertain, but it does not seem likely that we have reached finality yet. There are many of the more refractory metals about which little or nothing is known as it is difficult to get them pure, and impurities especially if they consist of metals of a different class altogether, are apt to reduce the melting point very seriously. Then, again, some of the metals are exceedingly difficult to work because they decompose water and thus oxidise in the air. They may even combine directly with the oxygen of the air, but it is more likely that they are attacked by water.

It is also possible that some of the carbides will be available. Many of them decompose water, which would make them very difficult to make commercially; on the other hand, carbons are often very fusible, and have high specific resistances, so that they do not have the main fault of metals. It is said that one form of lamp is made of a compound of zirconium and tungsten. It is possible this is really a zirconide of tungsten, corresponding with the carbide. It is also possible that some of the silicides may eventually come into use.

Perhaps the question that interests most readers is not how the lamps are made, or how much better they may be in the future; but what effect they will have on the industry. There seems to be little doubt that the difficulties of making comparatively small lamps for pressures up to 250 volts will be overcome. High resistance lamps are already made, but generally for candle powers above 20. The difficulty is also overcome by using special fittings which take two lamps in series, or by using little transformers in the house in the case of alternating current. The points that excite most attention are, on the one hand, that the lamps are of too great candle power; and on the other hand, that they take too little power, so that the central stations suffer. What will happen in the future it is difficult to say; but it seems most likely that both difficulties will vanish as people get educated to like more light. This may seem a sanguine view, and electrical engineers have not had much reason to feel sanguine about anything lately, and the sensation may be unknown to most of us. But in the middle ages people had torches to give light, and the early lamps, which Greek statues and people like them had, must have given very little light. I can remember when we had one colza oil lamp in the drawing room. It was called a moderator, and the oil had to be wound up every now and then from the base of the lamp. This must have given some 20 c.p., but it threw very little light down on the table or on one's book. If one wanted to read he generally had a candle. Most of the candles had thick wicks, and we had snuffers in little silver trays. Then candles came in which did not want snuffing; but the tallow candle was always used in the back regions. Then, we were quite contented with light of this sort. Of course, there was gas in towns, and this gave much more light; but even in towns people used to light a room with an extraordinary abomination which hung from the ceiling and was covered over with tears of cut glass. This affair generally had three burners, each giving perhaps 10 c.p.; but each burner was covered in with a globe, and the hanging glass prisms and diamonds cast shadows and prevented the light from coming where it was wanted. Yet people were quite satisfied. Then the electric light and the incandescent mantle came; and now people like perhaps ten times as much light as they used to have, and complain if they cannot get it. What is the limit? Obviously people will go on taking more and more light, always thinking they have enough until they are shown how much better it is to have more, until finally they have as much light at night as in the day. If this is so, people will soon consider 20 to 30 candles as a small but convenient lamp. No doubt doctors will say that so much light is bad for the eyes, and that the glare is very harmful; but, after all, our eyes seem to have been adapted by nature for use in the day when there is plenty of light, and the sun itself is a fairly dazzling object, and it is not the least likely that we shall ever have artificial light approaching sunlight. Until we get beyond daylight it is not likely that we shall hurt our eyes by too much light: it is much more likely that they will suffer from excessive reading with too little light. At first, no doubt, central stations will suffer, and the consumer will find his bill reduced; but, in the long run, he will want more light, and the wire lamp will make the electric light the cheapest, as well as the most convenient form of lighting, and it will be a great benefit to the consumer and to the electrical industry.

THE PRESENT POSITION OF ARC LAMPS AND ARC LIGHTING.

By E. E. HOADLEY.

Lighting by means of arc lamps has, after a temporary setback, recently shown signs of a strong revival; such signs apply not only to arc lamps used by municipalities and others for the lighting of streets, but also to lamps used for the lighting of shops and business premises. It remains to be considered, first, what were the causes for the undoubted decline in the popularity of arc lighting experienced a few years ago, and the reasons for the recent boom in such lighting, which from all indications at present, bids fair to continue.

In the early days the lighting of large spaces or where large units of light were required could only be successfully done in a very limited number of ways, easily first among them being the use of the only arc lamp in general commercial use—viz., the 10-ampere 500-watt open type lamp. Its only competitors were then a much larger number of flat-flame burners arranged either singly or in clusters, or lamps of the Argand or similar types, incandescent gas lighting at that date being in too experimental a state to be considered a serious competitor. But in any case the effect obtained was so immeasurably inferior to that obtained by arc lamps, that those responsible for the financial side of the matter paid the large sums charged for arc lighting without grumbling, thinking that they were getting value for their money.

About this time, too, a large number of electricity supply stations were being erected throughout the country, in the majority of cases by the municipal bodies themselves, who were also the bodies responsible for the lighting of the streets, and in their endeavour to improve the lighting of these streets large numbers of arc lamps were erected. In some cases it must be confessed that in their zeal to obtain as much revenue as possible for the electricity supply station, these authorities erected numbers of arc lamps in streets which were quite unsuitable for lighting with such large units of light and in streets whose importance in no way justified the necessary large expenditure per mile.

Next came the advent of the enclosed arc lamp, and in a very short time the market was flooded with examples of this lamp, in many cases, admirable as consumers of energy, but execrably bad as light-givers. In some places these were used for street lighting, but their chief sphere was certainly the lighting, both inside and out, of the large shops and business premises.

The novelty of electric lighting for shopkeepers and others was now wearing off, and it was beginning to be insufficient for a tradesman to know that his premises were lighted by electricity to get him to believe that no improvement was possible in his lighting, and to pay the heavy quarterly bills for electricity with which he was confronted. It is one thing to get a consumer to pay a heavy electricity bill if he is satisfied with the light produced, and knows that he has a better effect than his neighbour whose premises are lighted by gas, but it is a tale of quite a different nature when the consumer is dissatisfied with the effect for which he is charged very heavily.

Now began the era of the incandescent gas mantle, and for the next few years electrical engineers all over the country were hard put to it to hold their own, and in few places was much headway made, except, perhaps, in the main shopping streets of our large towns.

The cause of our want of success was that we were handicapped by only having two weapons to fight with, one being the carbon filament glow lamp, either singly or in clusters, and the other the arc lamp of approximately 500 watts consumption. What was wanted was something between, something with more brilliance than the carbon filament lamp, and yet not so expensive to use as the ordinary arc lamp of that time.

Here was the chance for our gas friends, and to their credit let it be said, they made the most of it. By the help of persistent advertising, and in some places by influence in high places, the use of the gas mantle advanced by leaps and bounds.

Shopkeepers, dissatisfied with the none too brilliant effect of aged glow lamps or with the cost of arc lighting, replaced them with incandescent gas, obtaining, in the first place, greater brilliance of illumination, and in the second, financial relief. Local authorities adopted single mantles for side street lighting, and clusters of mantles either with ordinary or high-pressure gas for the lighting of main thoroughfares, and the bitterest pill of all, the City of London itself replaced a large number of arc lamps by high-pressure gas lamps; it is true that the lamps replaced were more fitted for the cases of a museum than for the streets of the first City of the world; it is also true that the electricity supply company responsible for the upkeep of the arc lamps were not asked to submit an offer, but with all excuses thrown in, it was a smart piece of work on the part of the gas people, and they deserve all the "kudos" they got out of it. The fact that the City of London had replaced its arc lamps by incandescent gas was not "hid under a bushel," but was advertised for all it was worth (and a little bit more). There were very few municipal electrical engineers who had not to answer questions, or to prepare reports, justifying the retention of the arc lighting in their own towns, to satisfy various members of the Corporations, many of whom used the City of London example as a lever, and said that what London did must certainly be the best thing for the town over which they helped to rule.

Electrical engineers are, speaking generally, good fighters, and possibly owing to this quality, or to the pendulum swinging towards them again, strenuous efforts were now put forth to capture the ground that had been lost, and to make sure that electricity had its fair share (at least) of the new work that was going. This was achieved principally by improving the existing arc lamps and by putting other types on the market more nearly meeting the wants of the consumer.

Considering first the improvements of the existing types; these were purely detail improvements as regards the open-type lamps, conducing to steadier burning. As regards enclosed arc lamps, the greatest improvement for the user of the lamps was the substitution of single enclosure for the extremely wasteful double enclosure of the arc by means of first a small globe, generally of clear glass (when new), and then by means of an ordinary arc lamp globe of opalescent or ground glass; the chief trouble was the inner globe, which very soon became coated with a deposit from the burning carbons and changed from transparent to badly translucent. It is no use stating that an enclosed lamp will burn for 70 hours with one pair of carbons, if, in order to obtain anything like good results, it is necessary to clean the inner globe after each night's burning; in most cases this is not done, as to the average man it is far too much trouble to wipe the globe every day when the makers say that the lamp will burn 70 hours with one trimming. With single enclosure combined in a large number of modern enclosed arcs with a higher current density at the carbons points, by using smaller carbons, very good results can be, and are, obtained. A globe from 6 in. to 8 in. in diameter of the proper degree of translucency has the appearance of a ball of pure white light; this is all brought about by strict attention to details—right size and quality of carbons, right current density per square centimetre of carbon tip, right size and opacity of the globe and correct arrangements for the right amount of restriction to the inlet and egress of air and the products of combustion.

Lamps with single enclosure are in commercial use, giving exceedingly good results with currents from 2·2 amperes upwards. From four to six amperes seem to be most generally preferred, and in some of our London suburbs whole rows of shops can be seen, the outsides of which are lighted by means of these lamps and the effect is exceedingly fine; the smaller lamps take about 2·2 amperes, and consume a quarter of a unit per hour compete with clusters of incandescent mantles, and are exceedingly useful owing to their small size for the interior lighting of shops and shop windows. In the smaller towns these lamps have been very successful, as 1d. per hour for a good light appeals to the average shopkeeper; in one town of 35,000 inhabitants over 200 such lamps are in use.

No commercially good results have been obtained with less current than the above, and it has been so far a commercial failure to run these small current or any other arc lamps in simple parallel on high voltage circuits, *i.e.*, from 200 up to 250 volts. The colour of the arc is unpleasant owing to the predominance of the violet rays, and the great length of arc renders it very mobile and unstable, and for shop lighting moving shadows are an abomination.

Of even more importance than the small current single enclosure arc lamps was the introduction of the flame arc. This was a reversion to old principles with improvements; the inclined carbons had been used and discarded years before, but combined with impregnated carbons and a magnetic control of the actual arc, results were obtained as far in advance of the then existing lamps, as incandescent gas light was in front of the flat flame burner.

The early flame arc lamps were fearful and wonderful things, a mass of clockwork and spiral springs, and they required overhauling about every 24 hours.

In spite of the badness of the lamps mechanically, the light given was so greatly in advance of all previous results that a very large demand for them at once sprang up. Some people, both makers and users, paid the penalty of other pioneers for being too early on the market, and in several places lamps were put up for important street lighting jobs, and after a few months' weary struggle—during which the lamps were more often out than alight—they were replaced by ordinary arc lamps. By the enterprise and experiments of many manufacturers, and by the still better school of trial and error under actual conditions of use, flame arc lamps were designed and made which fulfil the required conditions very well indeed, and, judging by the number that are seen, there is a large field for their sale and use. For street lighting, the fact of their generally short hours of burning is against them, but the exceedingly ingenious magazine of carbons and its mechanism enable this to be got over.

The flame arc lamp is not at present by any means perfect. The points that can be urged against it are: first, high carbon cost, in some cases the cost of carbons approximates to the cost of the electrical energy; where cheap carbons can be used, as in magazine lamps, other drawbacks are introduced, viz., every time a new pair of carbons comes into operation the light is extinguished for a short time, varying from 10 to 30 seconds, and the complicated mechanism of the carbon-feeding and changing gear is out of place inside the case of an arc lamp.

Although great advances have been made in flame lamps, plenty still remains to be done, particularly in the direction of the use of cheap short carbons, with a very much simplified mechanism.

Even now many towns have replaced 500-watt ordinary lamps with flame lamps taking from 270 to 300 watts, and they are obtaining, if anything, better lighting results.

To sum up, arc lighting is at present booming chiefly in the direction of flame arc lamps and in single enclosure small current lamps. Manufacturers have still further fields to conquer; a simple and reliable miniature flame lamp would be welcomed, and the mercury arc offers great possibilities as soon as the colour difficulty has been solved by the proper method of alloying, or in some other way rather than by using the light from under-run carbon-filament lamps in conjunction with the light from the mercury arc.

Only by constant endeavour and unceasing experiment can the engineers of supply stations and contractors be provided with the proper weapons to fight their competitors, whose numbers are largely increasing, chief among them being the gas mantle, ordinary and high pressure, acetylene gas, petrol gas, and lastly, a light which is a sort of glorified Nernst lamp heated by gas.

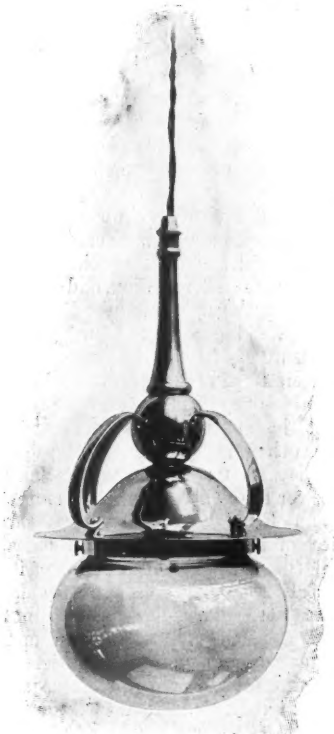
LAMPS AND LIGHTING ACCESSORIES EXHIBITS.

The Sunbeam Lamp Co., Ltd. (200, 201).

No introduction is needed to the Sunbeam lamp; in one form or another it has found its way to many parts of the world. Many of our readers are doubtless aware of the company's efforts to produce a high-voltage metallic-filament lamp; that these efforts have successfully materialised will be gauged from a visit to their stand, where a full range of these lamps, for circuits of 25 to 250 volts pressure, are on view.

The candle-powers range from 8 to 100, with an efficiency of 1¼ watts per C.P.

Sunbeam Metal-Filament Lamps.



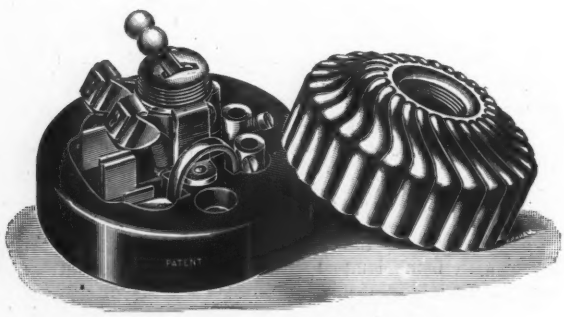
A Sunbeam Fitting.

The 25-volt lamp for house lighting is produced with a comparatively small pear-shaped bulb. The company claims a lessened risk of breakage in transit owing to the form of filament which has been adopted; the shortness of the bulb is also a feature.

Other Sunbeams are the carbon type lamps, heating lamps for radiators, and a variety of fancy lamps for decorative purposes.

The company are specialising in coloured lamps, their glass works offering special facilities in this direction. They have a large business in electrical accessories, fittings, switches, holders, ceiling roses, &c., and these, together with a selection of Messrs. Lundberg's specialities, are on view.

In connection with the latter, Messrs. Lundberg's "Twinob" switch is a novelty, consisting of two distinct pivot switch movements on the usual size base. A special mica insulation is used in these switches for attaching the contact arms and pieces; the contact arms also are locked when in their "on" position.



Lundberg's "Twinob" Switch.

Union Electric Co. (175, 231).

Many of the company's arc lamps adorn this stand. First and foremost come the "Excello" flame arcs, eight of which, four direct-current and four alternating-current, are suspended from the ceiling with a view to demonstrating that the alternating-current lamp is equally as efficient as the direct-current type. In fact, the company claim that the operation of the former type is the better of the two. These lamps are shown burning both yellow and white flame carbons. Two sets of inverted arc lamps are on view, these being more particularly intended for reflected lighting; over the entrances to the stand are placed "Koh-i-noor" arc lamps of a recent type, giving the advantages of colour truth appertaining to the open-type pure carbon arc, and, at the same time, long-burning hours.

A photographic arc of the kind usually employed in printing process work is shown in the centre of the stand, together with various types of projector lamps.

In the small enclosed show-rooms on the stand other types of arc lamp are shown, including twin carbon enclosed, ordinary enclosed, special enclosed lamps suitable for tramway and railway lighting circuits, the "Snowball Excello" arc and the "Coltru" daylight arc—the latter being a particularly suitable exhibit in view of the local industries.

Lundberg's "Twinob" Switch.

Electric and Ordnance Accessories Co., Ltd. (1, 62).

This company are showing various specialities in arc lighting, including the "Victor" standard and miniature enclosed arc lamps for direct-current circuits, and "Victor" flame arc lamps.

Both classes of lamp are of simple construction, the patented "Victor" clutch being the only moving part in each case. In this clutch the body consists of a solid brass casting, having a cylindrical hole bored through to take the positive carbon, and slotted at the lower end to allow a soft iron armature with a "Steatite" grip to be pivoted therein. This armature envelopes the top half of the clutch body. At the top end there is a soft iron core enveloping the body, halfway round.

The clutch is supported in the air-gap formed between the end of the series magnet core and the magnet frame.

When the current is switched on, a magnetic pull is exerted on the clutch armature, causing the "Steatite" grip to firmly hold the carbon; at the same time the whole clutch is drawn up, seeking to take a balancing position in the air-gap, thus striking the arc.

J. & H. Grevener (210).

This firm have a fine show of arc lamps of every possible description, and all types are made for direct and alternating current. One of their leading lines is the "Arcoflame" intense flame arc lamps; both A.C. and D.C. lamps are made in 10 and 16-hour patterns, and it is apparent in examining the mechanism, which is of substantial construction and is nickel-plated, that it would require very careless handling to make them go wrong. Messrs. Grevener here show their 4½-ampere flame lamps burning as steadily as a 10-ampere lamp.

Another very interesting type is the vertical carbon low-voltage flame lamps, which are particularly intended for factory lighting, &c. These burn 26 hours at one trimming, and six lamps can be run in series on 220 volts, or, of course, three on 110 volts. There

Enclosed Arc Lamp.

"Arcoflame" Lamp.

is an undoubted demand for this type of flame lamp, which requires a minimum of trimming, distributes the light over a great area, and also keeps the carbon cost low.

Several types of enclosed lamp are on view, including an exceedingly steadily burning small pattern single-enclosed lamp, burning 25 hours at one trimming, the current consumption being 3 and 4 amperes at 75 volts; and among the double-enclosed lamps are 200-hour and 65-hour patterns, which are made either for street lighting or with various patterns of reflector for inverted indoor lighting, especially for schools and offices.

Messrs. J. & H. Grevener are in a position to supply every conceivable requisite and accessory connected with arc lighting, and they have on view various designs of transformers, resistances, short-circuiting devices, chokers, circuit-breakers, couplings, winches, insulators, pulleys, wire rope, &c.; also a selection of dynamo and motor brushes, cables, flexibles, accessories, conduits, &c.

The Abbey Electric Co. (204a).

The company is exhibiting the "Abbey" flame arc lamp, for which extreme simplicity, durability, and freedom from any chance

"Abbey" Flame Arc Lamp.

of sticking of the feeding mechanism is claimed. Practically the only moving parts are a large toothed ratchet-wheel, and a double click or rocking lever. These work in conjunction with two solenoids in such a way that inclined carbons are allowed to fall a specified distance for each feed, and then are stopped by a tooth on the ratchet wheel. This movement is repeated about every 15 minutes when the lamp feeds, and a positive action is assured.

Each feed takes place in exactly the same place each time, and consequently the variation in the voltage of each lamp is reduced to a minimum, thus making it possible to place more lamps in series on any given circuit, the maximum variation per lamp being three volts. The carbon slide is made to work very freely, and with the minimum amount of friction, also the economiser is made of cast-iron, thus doing away with any chance of breakages or cracking with the heat.

The lamp works equally well on both alternating and continuous current, and is made very substantially throughout.

British Westinghouse Electrical & Mfg. Co., Ltd. (103, 79).

Among the wide range of exhibits shown by this company will be found flame and enclosed arc lamps, Cooper-Hewitt mercury vapour lamps (four of which illuminate the outside of the building), tungsten and carbon-filament lamps.

The flame arcs are of the Westinghouse-Bremer patent type, in sizes from 6 to 13 amperes, for burning on either continuous or alternating-current circuits. The three types made are single and double carbon, and magazine. These lamps, as well as the enclosed type, are in use at the Exhibition.

The tungsten lamps are shown fitted in handsome electroliers, which, with other similar fittings, form a special and unlooked-for feature of the company's stand.

G. M. Boddy & Co. (198).

The feature of this firm's stand is the "Metalik" lamp, in sizes varying from 16 C.P. to 100 C.P., and suited to pressures of 50 to 250 volts. The filaments are supported at the bottom, and the loop

Low-Voltage Type. High-Voltage Type.

"Metalik" Lamps.

is insulated by means of a special process; it is claimed that the increased rigidity obtained enables the lamps to burn in any position. To illustrate this point, a number of lamps are shown burning at various angles, from vertical to horizontal, without a sign of discomfort; and a "Metalik" lamp connected to a short length of flexible is swung round whilst burning, to demonstrate the strength of the filaments. A show-board fitted with this and other kinds of lamp, which can be put in circuit with a watt-meter, is used to show the great economy resulting from the high efficiency of the metal-filament type.

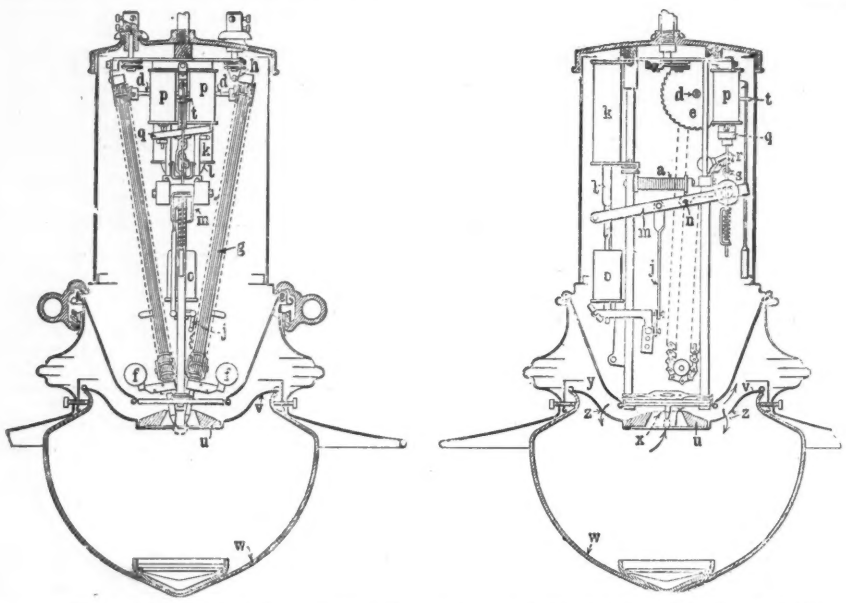
Messrs. Boddy are also exhibiting various types of carbon and tantalum lamps, so that visitors in search of "light" will be well advised to call at the stand, which is a blaze of illumination.

Robertson Electric Lamps, Ltd. (217, 187).

The exhibit of this firm is based on the lines of their popular exhibit at the Olympia Exhibition, but in addition, the firm, who have since acquired a large glass works in England, are showing a model of one of the glass cones at their Lemington-on-Tyne works. The stand occupies a prominent position in the centre of the building; skilled operators from the Hammersmith works are in attendance to demonstrate some of the processes of the manufacture of the well-known Robertson electric lamps, but owing to the very stringent regulations governing public exhibitions, several of the most interesting processes of glow-lamp manufacture are, unfortunately, omitted.

Oliver Arc Lamp, Ltd. (141).

The "Oriflamme" lamp for street, railway, dock lighting, &c., is the feature of this company's stand; some 28 of these lamps are also employed in the general lighting of the Exhibition.



a, Blow magnet; d, Rachet wheel spindle; e, Ratchet wheel; f, Magazine balance weights; g, Magazine; h, Hinge for magazine; j, Dashpot link; k, Control solenoid; l, Control solenoids, plunger; m, Rocking lever; n, Rocking lever, fulcrum; o, Dashpot; p, Racking solenoids; q, Racking armature; r, Mercury switch; s, rocking lever link; t, Pawl rod; u, Intensifier; w, Globe; x, Carbon tips and arc; y, Dust chamber; z, Removable spinning.

THE OLIVER MAGAZINE ARC LAMP.

The lamp is of the magazine type, the magazines containing sufficient carbons to give the lamp a burning life of 36 to 40 hours with each trimming. The magazines hold from six to nine pairs of carbons, and are placed opposite one another, having a V formation.

THE OLIVER ARC LAMP, EXTERIOR.

The movements of the striking mechanism are controlled by the differential solenoids. Each magazine is provided with an ingenious carbon "conveyor," and the two chains are worked simultaneously from a toothed wheel which is pulsated electrically by a small magnet in the upper portion of the lamp. This racking down of the carbons goes on at regular intervals, and when a pair is burned out the ends are discharged into the globe, and a new pair immediately moved into position. The changing of the carbons occupies about 20 seconds, during which period, of course, the lamp is extinguished.

Particular attention has been paid to ventilation; in the "Oriflamme" lamp there is a special chamber provided above the intensifier, and between it and the mechanism, and in this space the dust and other deposits collect.

The "Oriflamme" is made in three standard sizes for continuous current—viz., 7, 9 and 11 amperes, and five lamps may be burned in series on 200 volts, so that with 9 amperes (the usual size recommended for street and general lighting) the total wattage consumption per lamp including all losses in line resistance, &c., is only 360, or just over one-third of a unit, giving 1,200 mean hemispherical candle-power.

On alternating circuits it is usual to burn the lamps in single parallel, and these can be made to consume 220 actual watts only. The size generally recommended, however, is the 340 actual watts lamp.

The cost of carbons in the "Oriflamme" lamp is only about ·11d. per lamp-hour.

Gilbert Arc Lamp Co. (135, 159a).

This firm are well known as specialists in arc lamp manufacture, and their exhibit includes a variety of their recent types of lamp. Among these may be mentioned four-carbon and two-carbon flame arcs, the multiple carbon lamp, and a variety of enclosed lamps and accessories.

The four-carbon lamp is of compact design, and can be trimmed without removing the cover. It is especially suited to shop lighting, and is made in three sizes, for 10, 17 and 30 hours. The two-carbon lamps has a particularly sensitive feed, the feed variation being limited to 3 volts. This lamp also is compactly built, and attention has been given to the protection of the mechanism from fumes, &c., and to keeping the globe free from deposit.

The multiple carbon lamp is claimed to be a simple solution of the long-burning flame lamp, its burning hours averaging from 50 to 60. It is specially adapted for street lighting purposes.

The standard enclosed lamps are of the company's rod-feed pattern with single enclosure and a powerful control, this type having been largely adopted for street lighting.

Mention may be made of the carbon-feed and small enclosed lamps, also the several patterns of raising and lowering gear and accompanying winches, automatic cut-outs, switches, transformers, &c.

D. H. Bonnella & Son, Ltd. (248).

This is a special show of motor-car accessories, such as roof lights, switches, cord connectors, accumulators, with interior fittings generally. The latter fittings are in the firm's non-flammable ivoride, also in horn, ivory and mother-o'-pearl. A collection of flush ornamental and plain switch and push fronts in ivory, ivoride, metal and wood, also samples of pushes in wood, ivory, ivoride and brass, is shown, as are also Shadoless candle fittings, which will probably appear with metal filament in the course of the next few days.

Messrs. Bonnella also show their patent Simplex holders and patent shade carriers, a number of accessories, such as adapters, Pressel switches, cord connectors and switchboard labels, some of these being in various colours of ivoride.

For the patent "Crystalite" reflectors for shop lighting the firm are sole agents. The principal feature of these is that the bracket carrying the lamp-holders and lamp is hinged, and can be turned right back for the purpose of cleaning the reflector.

The General Electric Co., Ltd. (132, 162).

The exhibit of the General Electric Co. is one of the most prominent in the Exhibition, and one of the largest, occupying over 1,100 sq. ft.; it includes representative items of all their varied manufactures, of which for the moment we are only concerned with the lighting features. The exhibit is open on three sides, all round which are arranged specimens of the latest types of street lighting fittings, containing high-candle-power Osram lamps—the well-known tungsten lamps which the company introduced, and are about to manufacture at their new works.

Suspended from the street lamp-posts round the stand are festoons of "Pixielite" strip, bearing Osram lamps about 12 in. apart. The whole of this "Pixielite" is painted white, and imitation smilax is artistically interwoven with it, making the effect extremely pretty.

From each corner of the ornamental office in the centre of the stand four "Angold" magazine flame arc lamps are fixed, and from two other pillars on the stand specimens of the "Flamgold" arc lamps and open-type band-brake lamps, as well as various types of arc lamps, enclosed and miniature patterns, are shown. A number of the magazine Angolds are also in use for the general lighting of the Exhibition.

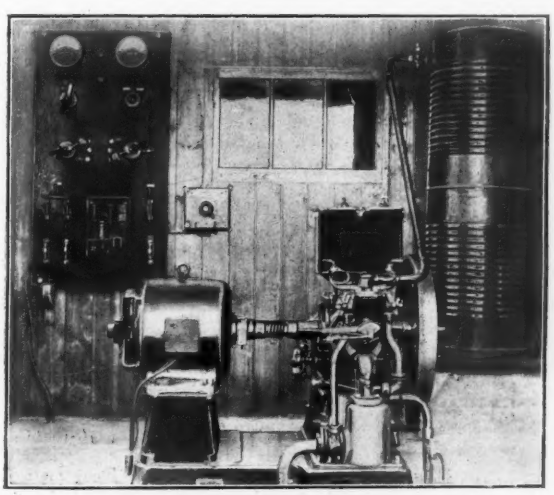
A good display of the latest designs in electroliers and brackets is given in the front part of the ornamental office, table and standard lamps being placed in prominent positions. The General Electric Co.'s insulated hand lamps are shown, and the new Osram candle lamp, which gives a pure white light, is exhibited here, and in Goodall's Model House next door. Wires and flexibles are also exhibited, and an elaborate panel has been prepared showing "Geekoduct" conduit and insulated fittings.

Among the exhibit of heating and cooking apparatus a new form of radiator (Holmes patent) is displayed; this contains ordinary heating lamps mounted inside vertical cylinders, which promote a free circulation of hot air. A great success is anticipated for this new type.

Yacht type projectors, of which the General Electric Co. are making a special feature, are mounted on the top of the stand in a very prominent position. A special show-board of Osram lamps demonstrates to visitors the advantages of these lamps over other kinds. On the same board, all types of high-voltage and low-voltage lamps for angle and vertical burning are shown, and over the front of the exhibit there is suspended a large sign, 12 ft. long, with the words "OSRAM LAMPS," outlined with 25-volt 16-c.p. Osram lamps, in conjunction with which a transformer is at work. A paraffin engine dynamo lighting set, for the lighting of country houses, isolated hospitals, yachts, &c., with the 25-volt Osram lamp, is also shown, the high efficiency of this lamp having given a great impetus to the electric lighting of small houses by these methods.

The Heatly-Gresham Engineering Co., Ltd.

This firm's chief exhibit, which we illustrate, consists of a complete "Rational" electric lighting set, capable of lighting from the battery 228 10-c.p. metallic-filament lamps for 10 hours. The set comprises one 6-b.h.p. "Rational" patent oil engine and a 3½-kw. 50-volt "Zone" dynamo, direct-coupled by a spring coupling, and mounted on a cast-iron combination base-plate; a standard switch-board fitted with moving-coil instruments, and the necessary switches; and a battery of 27 cells of Pritchetts & Gold's manufacture. The set is used for lighting the stand. Several other generating sets consisting of "Rational" patent oil engines coupled



"Rational" Electric Lighting Set.

to dynamos of outputs from 1 to 7½ kw. are shown, as well as a 3-h.p. combined "Rational" engine and vacuum pump suitable for working vacuum cleaners, milking machines, &c., and for driving a dynamo, forming a very useful combination for a farm or country house.

Metallic-filament lamps are recommended for use in connection with these sets, and owing to their great economy, they will, no doubt, enormously add to the popularity of such sets for country house lighting. Special attention is drawn to the space occupied by the set at work, representing the size of room necessary for it, and to the strength and accessibility of all parts of the engine and other apparatus.

Edison & Swan United Electric Light Co., Ltd. (22, 46).

This is a very good and interesting stand. In addition to an extensive selection of the "Royal Ediswan" and "Royal Ediswan Metfil" lamps, the latter being the name given to the new metallic-filament lamp manufactured by the firm at their Ediswan Works, Ponder's End, Middlesex, the stand contains examples of practically everything electrical, from the large illuminated sign down to the small pocket voltmeter for cell-testing purposes. A large example of the new "Ediswan Luxol" signs, with the wording "Royal Ediswan Lamps," is fixed in a prominent position. This Sign Letter is made of glass, in colour and appearance like snow ice, and equally visible by day or night. It has a full, rounded surface with bevelled extremities, so that by daylight it reflects the light at every angle. The under surface is hollow, and the curves are such that at night a single 5-c.p. lamp is sufficient to illuminate thoroughly every portion of a 6-in. letter, or two 5-c.p. up to 12 in., and three 5-c.p. up to the 16-in. letters. The rounded face of the letter only appearing above the surface, the sign may be read at a much greater angle than the ordinary facia or flush sign, or any front illuminated letter. If required, the signs can be arranged to be worked by a motor-driven switch—*i.e.*, for changing colours, blinking, or switching on letter by letter. The Ediswan arc lamps, also manufactured by the firm, are shown in all types, from the yellow flame, burning with impregnated carbons, to the remarkable white flame pure daylight effect arc, burning with pure carbons, and giving a spectrum exactly similar to daylight. Ediswan fans are also largely in evidence, the types shown ranging from the standard type of table, trunnion, and bracket fans, to the ordinary porthole and powerful box-bladed porthole patterns. A regulator suitable for use with the larger patterns is also shown.

The accessories section is strongly represented, and contractors may see here examples of all accessories used in general wiring work, as well as a number of patterns which are suitable for the largest installations. Amongst these will be seen the large knife switch type of cut-outs in iron cases, designed for use as main fuses on house or power circuits. The 25 and 50-ampere sizes are of the tubular type, the larger sizes being specially designed for heavy work. The firm's switchgear includes the Ediswan circuit-breaker, the improved pattern knife switch, the small point switch, and the "Phlatta" (which is shown in both round and rectangular patterns). The last-named switch has an extremely small projection, and is made on the Ediswan wedge system. It can be used in places where the ordinary wedge tumler switch would not be so suitable. Amongst the accessories are samples of every possible type of lamp-holder, ceiling rose, cut-out, adaptor, flex coupler, &c. The "S" insulator type of holder was originally introduced and patented by the Edison & Swan Co. to meet the demand for a high insulation lamp-holder for use on high-voltage circuits. There is also a collection of the firm's measuring instruments, including examples of illuminated dial voltmeters, vertical edgewise, and horizontal edgewise volt and ammeters instruments, with front and back connections, sector pattern instruments, the Ediswan horse-power meter, calibrated to read directly in horse-power, showing the output of any machine at a glance. There is also a large range of portable instruments, galvanometers, pocket voltmeters and testing sets. Further, there are many examples of fittings of all types and finishes, including a complete range of ship and traction fittings.

The Walsall Hardware Manufacturing Co. (210a).

The special feature of the Walsall Co.'s exhibit is their grip fitting, which is combined with the elbows, crosses and other usual fittings, and consists of a collar pinched tightly upon the tubing by means of a screw. The company are showing a varied assortment of close-joint, welded and seamless tubes, standard and special fittings for use with them, and malleable iron castings, of which they make a speciality.

Chamberlain & Hookham, Ltd. (195).

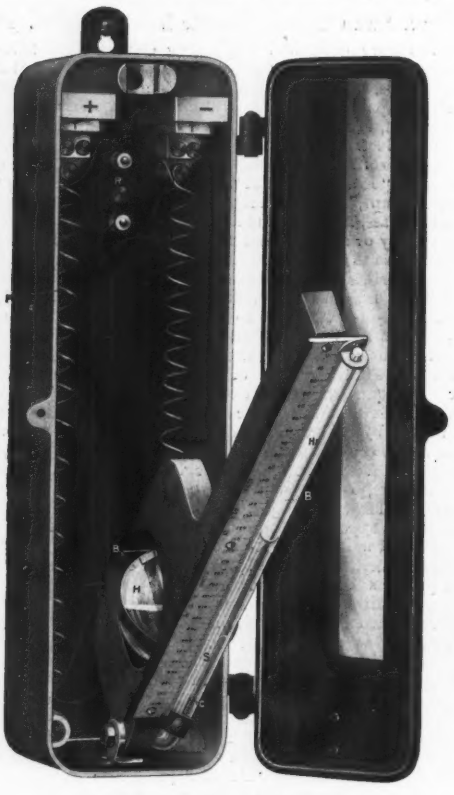
This firm are showing all their types of meters, together with sections showing the working parts. The most novel and interesting of these is the new watt-hour meter. This meter has no brushes or commutator, and is not affected by stray magnetic fields. Essentially it is a modification of the well-known ampere-hour meter, in which the permanent magnet driving field is replaced by that of an electro-magnet; the permanent magnets are still retained for the brake.

The armature is similar to that employed in the ampere-hour type of meter, and carries on its spindle the aluminium brake disk.

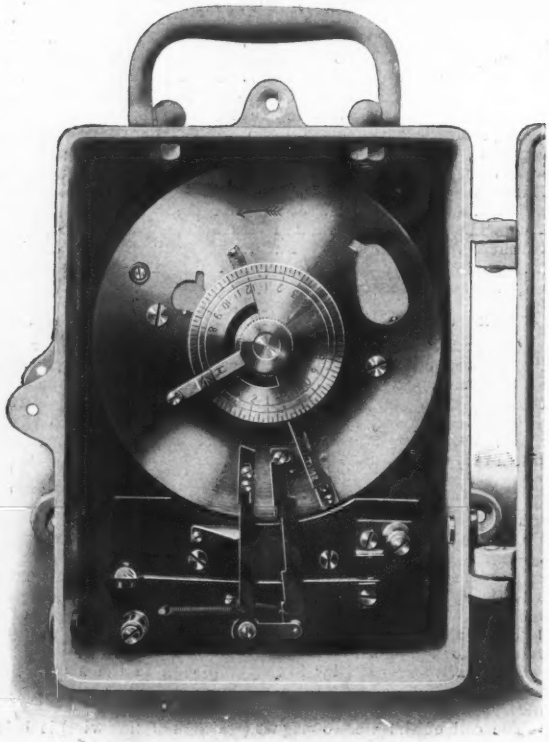
The coil of the electro-magnet (which is of fine wire) is below the mercury bath. It is wound upon a straight core which carries one pole-piece at its upper extremity. In order to ensure entire absence of residual magnetic effects in this core, a special method of construction has been adopted; instead of being made of a solid bar, it is made up of a pile of iron washers with insulation between them. When magnetised, therefore, the entire iron circuit is made up of a number of magnets very short in proportion to their area. These magnets have a great self-demagnetising tendency, which operates the moment the magnetising current is withdrawn or diminished.

The top of the bath is covered by the upper pole-piece, in the centre of which is a gland which may be operated by a screwdriver through

one of the holes in the brake disk. When raised, this gland lifts the armature off its jewelled bearing, holding it tight during transit, and prevents loss of mercury. Although the armature is considerably larger than in the firm's ordinary ampere-hour meters, its weight is entirely borne by the mercury, so that there is no tendency



HOLDEN ELECTROLYTIC METER.



VENNER TIME SWITCH, TYPE B.

for the pivots to wear. These meters start with ½ per cent. of full load, and are accurate down to $\frac{1}{20}$th of full load.

The Manchester Corporation is adopting these meters for power consumers. Other types of great interest are the penny-in-the-slot, electrolytic, and cash register meters, a new type of battery meter, and the Lackie demand indicator incorporated with a standard Hookham meter.

The electrolytic meter is made under Holden's patents, and is of the shunted type, only one fifty-thousandth of the current passing through the electrolyte. This consists of dilute sulphuric acid, which, together with the platinum electrodes, is sealed up in a glass vessel. The electrodes are coated with platinum black, and the anode partly projects out of the electrolyte into an atmosphere of hydrogen, which it readily absorbs. When an electric current is passed through this vessel, the hydrogen absorbed by the anode combines with the oxygen which would otherwise be evolved there, while an equal amount of hydrogen is liberated at the cathode and rises into a vertical tube having a scale behind it, upon which its volume is measured. The scale is graduated to show Board of Trade units at the voltage desired. When the measuring tube has become filled with hydrogen (corresponding to, say, 300 Board of Trade units) it may be tilted forward, and the meter thus again started at zero. A side view of the meter is shown, partly tilted forward out of its case.

The two-rate meter is of the Hookham 1897 type, fitted with a counting train having two sets of dials. The change-over from the

HOOKHAM TWO-RATE METER.

lower to the upper dials is effected by a time-switch closing the circuit of a solenoid.

Other classes of goods on this stall are time switches by Venner and Co., for automatically switching on and off lamps, motors, signs and other electrical devices.

The Venner time switch, type "B," which we illustrate, is used with two-rate meters, and for other purposes where the current does not exceed 1½ amperes. It is provided with a high-class 45-day clock, and has a simple switch action.

The switch consists of only three moving parts. The make and break are both rapid, and the action is quite positive. Platinum contacts are employed to prevent oxidation, which causes trouble if a base metal is used. The switches can be arranged not to open or not to close circuit on any desired day or days, or any other selective arrangement can be made (*e.g.*, *later* switching on certain days) to meet every possible requirement. The Venner time switch has been approved by the Board of Trade.

The well-known "Credenda" conduits and the "Limpet" wall plugs are shown on this stand.

E. M. Evans & Son (238).

This exhibit consists chiefly of a large variety of illuminated signs. We understand that experiments have been in progress over a long period, and every conceivable medium and method has been tried with a view of obtaining an absolutely perfect "night and day" sign. The name of the firm has been prominently fixed over the stand, and letters patent have been applied for to cover the various details attached thereto. It is claimed for the firm's signs that they are uniformly lit, that due consideration has been given to heating and ventilation, and that all signs are so constructed as to make them almost dustproof. They claim that their signs can be worked automatically by means of the many switching apparatus that are now on the market. They can also be fitted with time clocks attached to the switching device, to do away with personal attention. The signs can be finished in wood, metal or any other substance to suit almost any business. Many existing signs can be fitted and illuminated with the firm's apparatus. A selection of glass shades suitable for metallic-filament lamps is also shown. In addition, a large number of hand-made electric light fittings are on view, suitable for residential work. These include a large assortment of switch-plates, finger-plates, door-plates, &c., in various styles and finish. The firm also exhibit several electric fans and ventilating apparatus, tell-tale clocks, telephone instruments, &c.

MISCELLANEOUS EXHIBITS.

Bray, Markham & Reiss, Ltd. (20).

This Walthamstow firm deserve more space than we, unfortunately, are able to devote to them. The B.M.R. switchgear shown has a suggestion of originality about it, not frequently found in the usual run of such work.

A notable example of their work is the ratchet type starter, made in sizes from 5 to 150 H.P.

The essential point about these starters is the ratchet slow-motion device, which, by ensuring that the contact arm rests fairly in the centre of each contact, while at the same time allowing rapid movement from one contact to another, eliminates the deleterious effect of sparking. To make assurance doubly sure, each contact is protected by a renewable carbon button, with which contact is first made. This idea has been copied in several instances, and is now frequently specified.

The starter affords complete protection to the motor, and it is interesting to note that the no-volt and overload releases are operative during the period of starting.

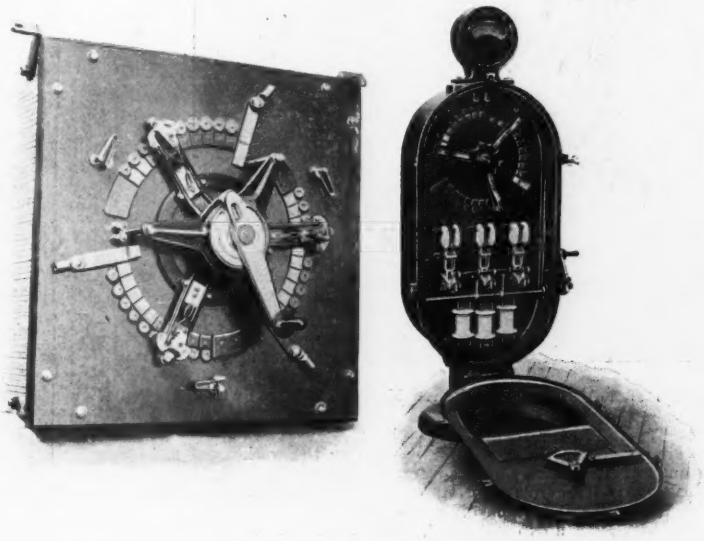
In this connection we illustrate standard and three-phase ratchet starters, also a three-phase panel of ironclad type, carrying fuses, main switch and starter, and with an ammeter mounted above the case.

The B.M.R. Admiralty switchgear has been brought out to comply with the latest Admiralty specification, which prohibits the use of slate or marble, and practically allows nothing but mica for insulating purposes.

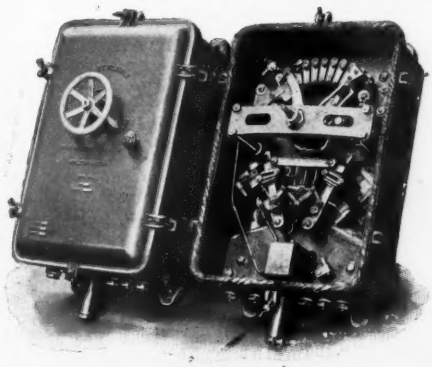
The particular starters, one of which is illustrated, supplied for Admiralty purposes, combine a D.P. overload circuit breaker interlocked with the starting switch, and so arranged that the movement of the hand wheel in one direction first closes the breaker, and then cuts out the starting resistance. The breaker can be tripped at any time during the period of starting, or afterwards, and cannot be held in a closed position against an excess of current.

We also show one of the firm's auto-transformers, in which it will be seen that the cores are held in a light framework, on which is mounted a circular switch, of the drum controller type. The switch is very compact, and can be easily worked either through a cover or immersed in oil.

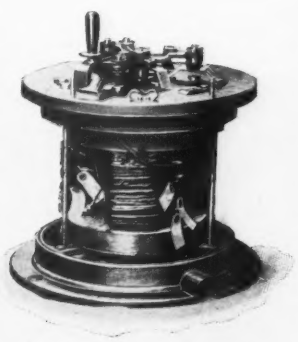
Messrs. Bray, Markham & Reiss also show their resistance units of both the wire-wound and punched wrought-iron grid type, shunt regulators of various types, the B.M.R. solenoid switches and automatic switches. In the latter, a small motor operates, through special gearing, what is practically a standard ratchet type switch. A solenoid is provided in series with the motor, so that when the relay circuit is closed the motor starts, and the solenoid allows the pawls to engage in the teeth of the ratchet. The motor is switched off when the starting-arm is "full on," though the solenoid remains closed. When the solenoid is released, the retaining pawl comes out, allowing the switch arm to return to the off position.



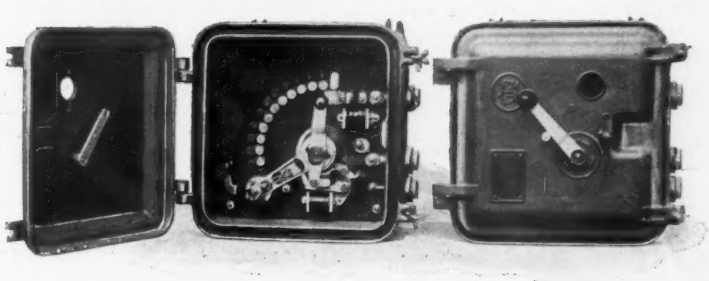
B.M.R. Three-Phase Ratchet Starter and Three-Phase Panel.



B.M.R. Admiralty Starter.



B.M.R. Auto-Transformer.



B.M.R. Standard Ratchet Starter.

The Bell Rock Belting Co. (270).

This exhibit includes three repeat orders which the firm have just completed for "Bell Rock" belts, prior to their delivery. These belts are of exceptional width and length, and should interest managers of works where wide main driving belts, conveyors and elevators are employed.

The three orders are as follows:—One main driving stretchless sewn cotton duck belt constructed with two solid round edges; 105 ft. long × 53 in. wide × 12 ply, capable of transmitting 750 H.P. travelling at a speed of 4,530 ft. per minute. Weight 14 cwt. 2 qr. One main driving stretchless balata belt, 100 ft. long × 31½ in. wide × 7 ply, capable of transmitting 300 H.P. travelling at a speed of 5,300 ft. per minute. Weight 4 cwt. 3 qr. 19 lb. One stretchless balata "Carrying" belt, 360 ft. long × 25½ in. wide × 3 ply.

W. Batty & Sons, Ltd. (294).

This firm are showing a new and improved system of electrically-driven clocks (Perret's patent) which has proved its utility in hotels, public buildings, offices and factories. The master clock is automatically wound every minute, and in the same action the current is distributed to the secondary clocks. The principal advantages claimed are:—No winding required; perfect timekeeping because of the regularity of the motive power; all clocks on the circuit work in perfect unison; absolute independence of outside influences; unlimited usefulness for controlling any number of other dials and ringing bells in different rooms at fixed hours, thus obviating the possibility of dispute as to the time for ceasing work.

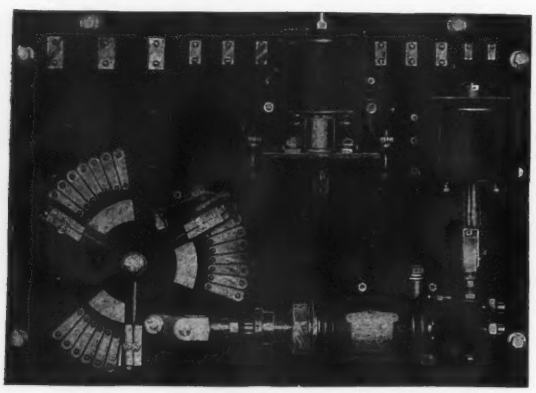
We understand that the system is working successfully on the Continent, and at the principal railway stations in Switzerland. An installation with the mechanism exposed is shown at the stand where details of its working can be fully ascertained.

Messrs. Batty also show a large variety of clocks suitable for switchboards, engine room, &c., non-magnetic watches in all grades, electrically-illuminated night watch stands, &c.

Adams Manufacturing Co., Ltd. (130).

The Adams Co. have arranged their exhibit with a view to demonstrating the potentialities of the "Igranic" switchgear. The bulk of our readers are aware of the diversity of applications for which the company's switches have found favour, also that a characteristic is the automatic feature which has been introduced into the working, with the object of eliminating the human factor as far as possible.

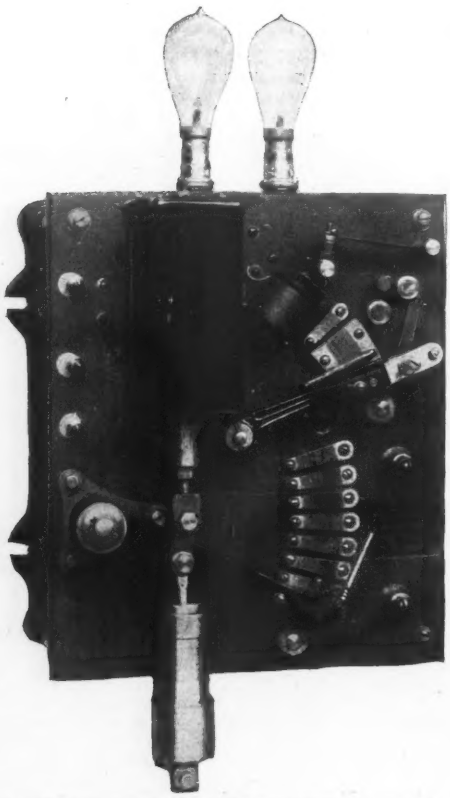
One of the exhibits which always appeals to the visitor is an electrically-driven automatically-controlled hydraulic accumulator —the control apparatus comprising a tappet or float switch, a self-acting motor starter, and a magnetically-operated main switch.



ADAMS SELF-ACTING THREE-PHASE MOTOR-STARTING SWITCH.

A similar apparatus is shown for controlling the working of a Gwynne centrifugal pump. An apparatus which we illustrate, is a controller for large rotary printing press work, much used in newspaper offices, and which gives a speed range of from 5 per cent. of maximum up to full speed, only one handle having to be manipulated.

The company's attention has also been directed to automatic control for alternating-current motors, and in this connection we illustrate

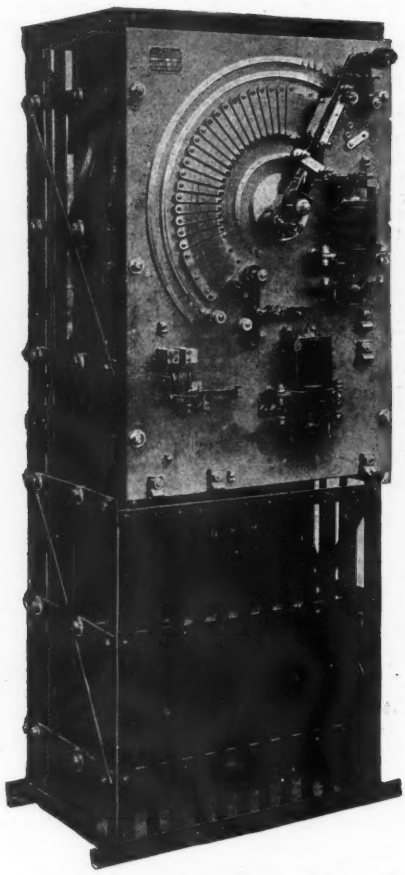


ADAMS AUTOMATIC STARTER (BROADBENT'S PATENT).

a self-acting three-phase starter. In this an oil-immersed solenoid-operated double-pole main switch is provided for the stator circuit, and electrically interlocked with this is a commutator switch for regulating the resistance in the rotor circuits. To move this switch over its steps, an air or hydraulic cylinder is employed—the valves of which are solenoid controlled. The interlock prevents the stator switch from being closed unless the starting resistance is in the rotor circuit.

A solenoid-controlled oil-immersed main switch is used where an alternating-current motor can be coupled direct to the mains.

The requirements of variable speed motors are met by combined starting and field regulating switches, examples of which are shown; and for reversible motors of this type, as used for machine driving, a special type of combined reversible switch is



ADAMS CONTROLLER FOR PRINTING PRESS WORK.

provided, which can be attached to a splined shaft and operated by a handle, which may be moved to any position along the face of the machine.

Among other features of the stand are the company's well-known push-button control, magnetically-operated contractor switches, &c., and the interesting automatic-starting switch patented by Mr. Frank Broadbent, which was recently noticed in our pages and is illustrated herewith.

Small & Parkes, Ltd. (10).

This firm are specialists in packings and beltings, a display of which is the feature of their stand.

Mention may be made of the "Karmal" packing, shown in different grades, and claimed to be suitable for all purposes, also of the "Roko" belting, the chief feature of which is a pile surface, which takes up the wear and tear of the pulleys without affecting the body of the belt.

Electrelle, Ltd. (116).

The Electrelle is a piano playing device, which will fit into any upright piano, and does not interfere with hand playing. We know that it is neat and compact, and for the rest—the makers claim that it is absolutely without musical limitations, except those of the performer's own musical perception.

Liverpool Electric Cable Co., Ltd. (196).

The company's stand does not lend itself to descriptive purposes; its business as manufacturers of vulcanised wires and cables, of which a large variety is shown, is sufficiently well known to our readers.

Chorlton & Knowles (67).

This firm specialises in the production of illustrated catalogues, circulars, price lists and show cards, especially for the use of engineers, textile machinists, &c.

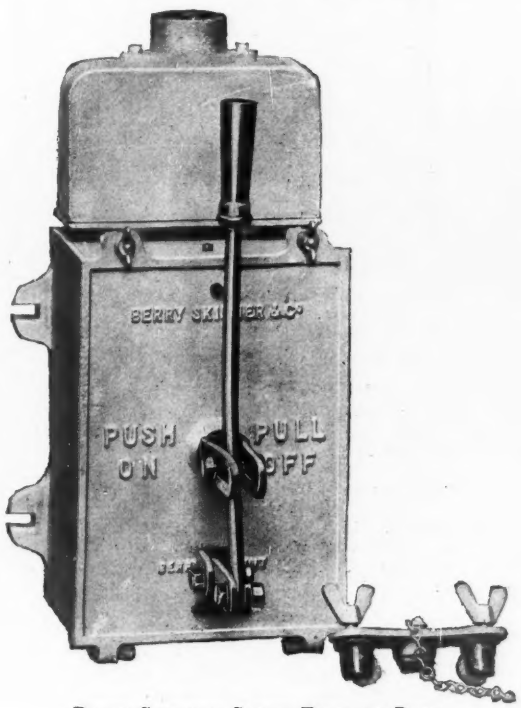
Harold Ashton (263).

Mr. Ashton shows a variety of apparatus, including ventilating fans, heating and cooking appliances, Ashton's anti-vibrators, a cheap little device for attaching to flexible suspensions, particularly where metallic-filament lamps are employed.

Berry, Skinner & Co. (188a, 216a).

A lengthy description of the Berry patent fool-proof switchgear is unnecessary in view of its extensive use. The company's apparatus, it will be remembered, was used throughout the lighting and power distribution circuits at the Franco-British Exhibition, and is similarly used over the whole of the Manchester Exhibition building.

The Berry combined switch fuse and plug for portable machinery in mines, workshops, &c., as shown herewith, figures on the stand,

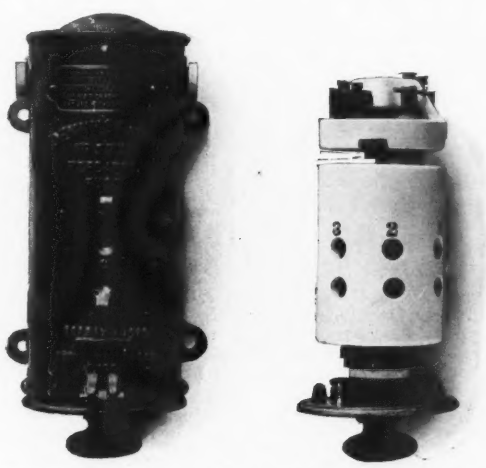


Berry Combined Switch-Fuse and Plug.

also the Denny patent repeater fuse, in which fuse replacements are made by turning a handle only. The fuse is suitable for use on cranes, lifts, capstans, &c.

It should be noted that the combined switch fuse illustrated above is both flame and water-tight, also that the plug can neither be inserted nor withdrawn while the switch is on and the sockets alive.

Messrs. Berry, Skinner's apparatus, consisting primarily of iron-clad units, can be conveniently assembled on skeleton framework, forming an exceedingly safe and convenient switchgear, entirely



The Denny Repeater Fuse, with and without Cover, Shown by Berry, Skinner & Co.

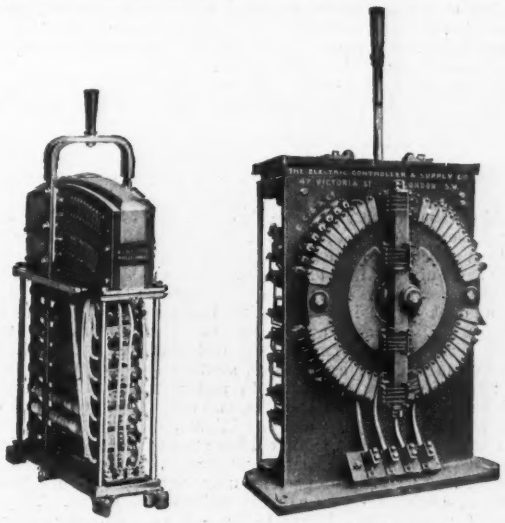
enclosed, practically fool-proof, and designed to comply with Home Office stipulations.

An example of a distributing panel, built up in this way for the Franco-British Exhibition, was illustrated quite recently by us.

A new primary battery, applicable to miners' lamps, motor and cycle lamps, ignition purposes, &c., and a compact CO_2 ice-making plant, are also shown on the stand.

Wellman-Seaver & Head, Ltd. (284c).

This company have been identified with American steel-works machinery for a great many years, and the fact that their well-known series of Dinkey controllers is the outcome of some 12 year's experience under the trying conditions obtaining in steel works, is



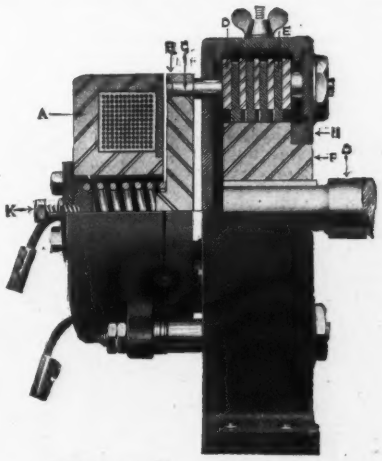
Dinkey Controllers, Types VF & V.

a sufficient testimonial of their reliability and usefulness under continuous working conditions.

The operation of these controllers is by means of a simple to-and-fro motion of the starting lever; the vertical position being neutral and gradual movement on either side corresponding to the direction of the motor rotation.

Where many controllers have to be operated by one man, as in the Wellman charger, the lever-type starter represents a great saving in time and trouble.

The company make four principal types of Dinkey controller; type V for the very heaviest service; type V F, which was designed for cramped situations, and is suitable for general industrial work; type G, suitable for ordinary overhead crane work; and type U, designed for small powers. The majority of these controllers are sold combined with resistances, the latter being of Eureka wire



Wellman Magnetic Brake.

wound on insulated steel rods and connected in such a manner that each resistance unit forms the magnetic blow-out for the particular contact to which it is connected. The banks of resistance units are easily replaceable, and the arrangement lends itself to a compact design.

The company are also showing their Wellman brakes, for which very good results are claimed.

Reference to our illustration will make the operation of this type of brake clear; the motor spindle G is coupled to a steel hub F provided with feathers which engage and turn the plates E.

The plates D are secured from rotating by the case, but all the plates can be moved axially. When the motor is at rest the magnet coil A is de-energised, and the central spring forces the armature plate B against the friction plates, holding the motor shaft; the starting of the motor, of course, reverses the conditions, the attraction of the armature plate overcoming the spring and releasing the friction plates. As the latter rotate in oil, the action of the brake is free from jar or shock—the principle being very similar to that employed in the Hele-Shaw clutch.

The company are also showing a new drum type controller and a series of starting switches, motor panels, &c.

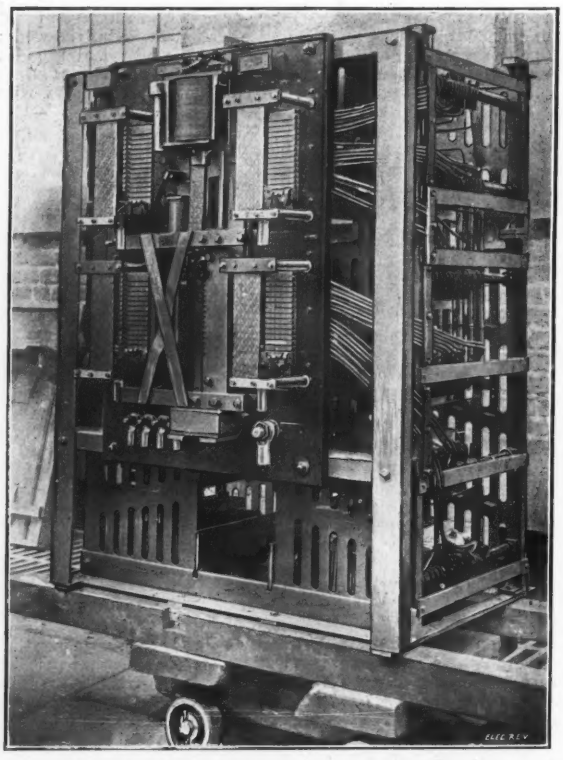
Bertram Thomas (185).

This exhibit consists essentially of switchboards, circuit-breakers and switchgear generally, the latter chiefly of the automatic type. Most of the automatic gear can be seen working.

A large number of the firm's circuit-breakers are exhibited, comprising overload, reverse, overload and reverse, &c., of various capacities, and all fitted with free handle and magnetic blow-outs. These instruments have been designed as "short breakers," and the apparatus is of substantial nature.

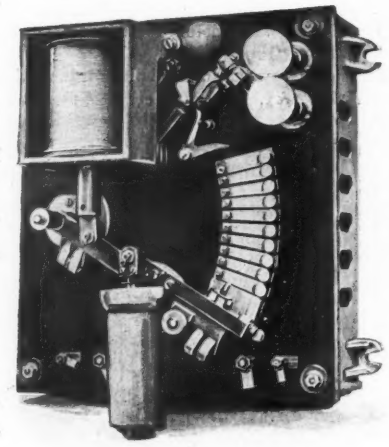
The adjustable time-limit devices—a speciality of this firm, and employed in their marine breakers for the British Admiralty—will be observed with interest.

Among the automatic starting switches shown, are the "Rack" type starters, the chief feature of which is the instantaneous movement of the contact arm from step to step when cutting out resistance, with a suitable and adjustable pause on each contact to enable the motor-current to settle down. This reduces the burning at the contacts to a minimum. Special attention has been paid to the protection of the main contacts and contact arms against the effects of sparking, all sparking being taken upon auxiliary renewable pillars or rollers. Carbons are not employed on account of their comparative frailty and high resistance. The main contact arms are of the controller finger type, and are therefore strong and durable. These starters are in use with air compressors, starting and stopping as many as 20 to 30 times an hour with motors taking currents in the neighbourhood of 1,000 amperes, and they stand up to these conditions with reliability and a minimum of depreciation. The quadrant type starters exhibited have the same characteristics of step-by-step movement, contact protection, and controller finger contacts, but they are designed for use with smaller motors. Several automatic solenoid-operated main switches are shown. They are made for durability. Magnetic blow-out is employed, and circuit is broken on substantial auxiliary metal fingers in the larger sizes. An example of their automatic battery regulating switch is shown working, together with its governor. It is a substantial piece of apparatus for private house installations and small central stations. Several air pressure limit switches are shown. They are of the piston type, and very powerful forces are employed for operating them. The heavy working parts are mounted on knife edges, and are therefore frictionless. Other limit switches for working from tappets on hydraulic accumulators, or from floats, are also exhibited, as are several ratchet-operated starting switches and various patterns of shunt-regulating rheostats available for different positions.



RACK TYPE STARTER FOR 1,000-AMPERE MOTOR.

In the switchboards department some eight panels are exhibited, each panel containing the apparatus for controlling a particular type of machine or circuit. The most interesting panels are two containing the gear for controlling generator and feeder circuits in a combined lighting and traction switchboard. The lighting panels have multiple bus-bars, and a system of plugs and interlocking shutters is provided for ensuring the use of the correct bars. The positive section is immediately above the negative, and convenience of working is obtained with a clear back and without crossing connections. The ammeters of the two sides of the three-wire lighting panel are mounted at the middle of the panel for convenience of reading. Two other panels contain the gear for controlling an automatic reversible booster.



QUADRANT TYPE AUTOMATIC STARTER.

"Climax" Hand Fire Extinguisher Co. (273).

This company, which was officially appointed to protect the Exhibition buildings, and whose stand is at the "Welcome Club," has a number of its chemical hand fire extinguishers in the Exhibition.

Le Carbone (120).

As this firm are the pioneers of the carbon brush in Europe Messrs. Le Carbone's exhibit of brushes, contacts, microphone disks, shot and powder, welding carbons, trolley wheel bushes, primary cells, &c., is well worth a visit.

The carbon brushes are designed for every purpose, and, indeed, their wide use is sufficiently eloquent of their successful use; the primary cells are all modifications of the well-known Leclanché type, but a special depolariser is employed which gives them a very large output and an extremely extended life. Several different types of this cell are shown.

A. G. Brown (14).

This exhibit consists of Simpson & Brown's patent vacuum and pressure dry insulating machine for electrical apparatus, and includes a motor-driven air compressor and vacuum pump.

This machine, which was recently described and illustrated in the ELECTRICAL REVIEW, is arranged for electric heating when other systems of heating are not available.

G. A. Steinthal & Boydell, Ltd. (227).

This firm is making a feature of the "S.B." patent contact plug, which is shown in connection with distributing boards using single and double contact plugs respectively, also in a switch arrangement for paralleling sections of an alternating-current armature with the double contact plug.

A magnetic separator is also shown, the special use of which is for recovering iron from the refuse heaps of blast furnaces, &c.

The "Clipper" Belt Hook Co. (300a, 301a).

The company show a selection of belt tools and hooks. The "Clipper" system gives a joint with both sides alike, which runs smoothly, and practically equals an endless belt; it is consequently favoured by electricians. Another new form of fastener is just being introduced called the "Clipper Cable." This consists of a closely-wound steel spiral on a wire core, which is very simple in application.

The "Clipper" girder clip for carrying tubes, also shown, is a very efficient device for fixing the clips to the girders, and forms an excellent substitute for the wood plug in concrete.

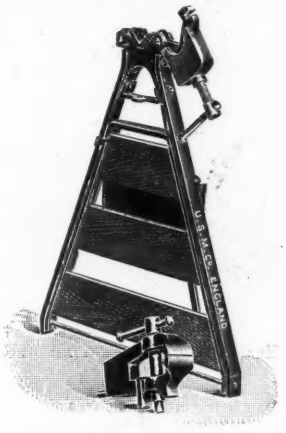
Congdon & Muir (174).

This firm show a model electric lift in operation on their push button system. They have also two or three types of the Kesnor patent lift controller, one of these being connected up to a compact little gear which is destined for a 6-cwt. passenger lift for a private house.

The firm are agents for the Union Electric Co., Ltd., and for Ozonair, Ltd., and they exhibit four types of apparatus for the production of ozone for the ventilation of rooms, offices, public buildings, &c.

Union Standard Machine Co. (193, 208).

Attention may be profitably directed to this firm's "Pioneer" portable work bench, which we illustrate. This bench is an acquisition for outdoor fitting, &c.; it weighs only 45 lb. as a pipe vice and 80 lb. equipped with a bench vice, and takes pipes up to 2 in. diam. or work up to 3¾ in. in the jaws of the bench vice. The



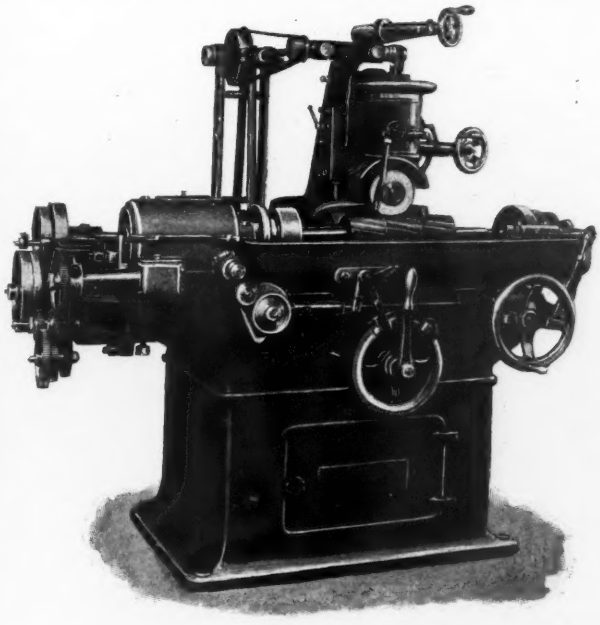
"Pioneer" Portable Bench, Folded up for Transport.

bench is absolutely rigid when in use, owing to the user standing on the platform, and can be folded into quite small compass when it is required to move it into another position.

Apart from the "Pioneer" bench, the company show a number of other tools of the portable type, including punching, shearing, planing and drilling machines, adjustable die-stocks, &c., which are equally worth inspecting.

Mayer & Schmidt (8 & 85).

This firm specialise in grinding machinery, and are exhibiting an automatic cutter grinder and an automatic twist drill grinding machine, both of which are necessities in the modern tool-room. The former machine is designed to rough out and sharpen milling



Automatic Cutter Grinder.

cutters of various types up to 8 in. diameter and 24 in. long. The grinding head is provided with an automatic feed, and can be turned on a vertical spindle; both emery wheels and emery cup wheels can be used.

The twist drill grinder is also automatic in action, and provided with the necessary adjustment for the clearance and cutting angle of the drill, both of which can be altered while the machine is running if required. We illustrate the former type of machine.

S. N. Brayshaw (259, 260).

Here are shown a large variety of milling cutters, the Brayshaw patent salt-bath furnace for hardening steel, and the twin-chambered high-speed furnace heated by gas. In the last-named, which we illustrate, coal gas must be used, as producer gas is not suitable for the high temperature required.

Compressed air must be supplied at a pressure of 1 lb. per square inch. The air supply is led into an air chamber provided with a safety valve, and thence it passes to the mixing chamber. Before entering the mixing chamber both the gas and air may be easily regulated by large graduated quadrant taps. The proportions of the

"Pioneer" Portable Bench, with Pipe Vice.

gas and air apertures have been carefully calculated and nicely adjusted, and the amount of gas consumed is reduced to a minimum, because arrangements are made to secure that it is burnt in the most efficient way. The consumption of compressed air is remarkably low, as most of the air required for combustion is drawn in by suction through an adjustable aperture. The mixing chamber and burner are of ample size, and have been accurately designed to give a very large flame, sufficiently powerful for the work, and yet entering the furnace with a gentle flow, rather than a violent rush. The burner is set at an angle, and points downwards into the

Twin-Chambered Gas-Heated Hardening Furnace.

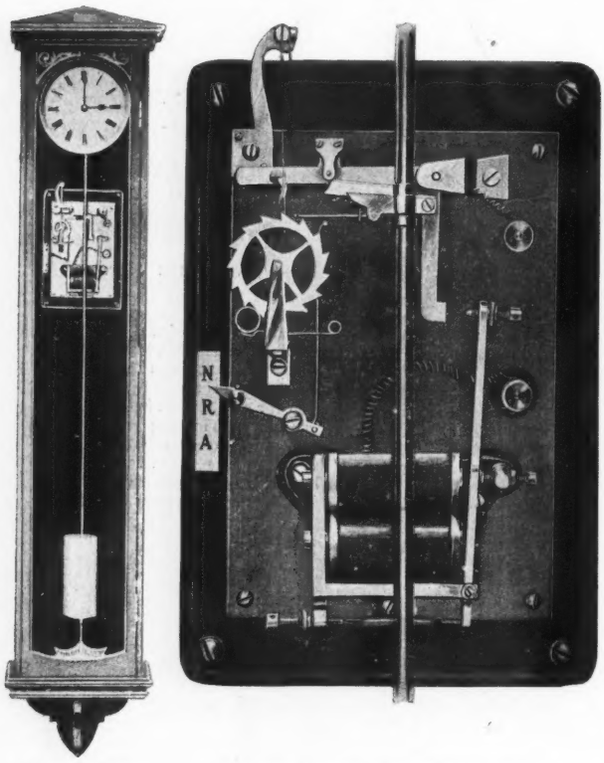
furnace, so that the flame on entering the bottom chamber, first impinges on the floor and then spreads out. In the design of the mixing chamber and burner, provision has been made to prevent lighting back.

During the Exhibition one of these furnaces is to be shown in operation at a white heat.

The Synchronome Co. (272).

This company exhibit their well-known "Synchronome" system of electrical time service, whereby any number of clocks are operated from a single self-wound electrical pendulum. Several patterns of this instrument are shown, with and without dials. They consist essentially of a pendulum combined with a switch in such a manner that both the time-keeping and switching functions are automatically performed with the greatest precision and security.

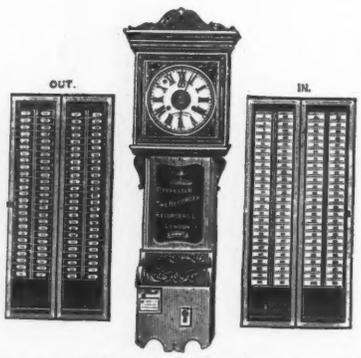
The guiding principle of the inventor of this system has been to employ a reliable and powerful switch to transmit the half-minute impulses for the propulsion of the dials, instead of more or less delicate spring contacts applied to the gently-moving wheelwork of ordinary clocks. The simple combination of the



MASTER CLOCK. ENLARGED VIEW OF PENDULUM SWITCH.
THE SYNCHRONOME SYSTEM.

switch with the pendulum which times its operation, carries with it certain fundamental advantages, such as an automatic warning of impending failure of the battery, also the impossibility of the switch stopping in closed circuit and thereby running down the battery.

An ideal time service is afforded by the system for railway stations, hotels, clubs, warehouses, colleges, hospitals and all public buildings.



ROCHESTER RECORDER.

Examples are shown of the application of the system to employés' time registers, electrical measuring instruments, bell programme clocks, &c. Independent self-wound clocks are also exhibited.

The current consumption of all instruments is said to be so small as to be practically negligible, and any source of electric supply may be used.

Dey Time Registers, Ltd. (122).

The "Dey" time register, for recording the time of arrival and departure of employés by means of a weekly combined time and wages sheet, is on show.

The latest improvement in the machine is a duplex ribbon attachment, which automatically prints the time of late comers in red ink, ordinary time being printed in blue. This enables the wages clerk to see irregular time at a glance. The machines are made in four sizes, viz., for 50, 100, 150 and 200 hands. For cost-keeping, by means of an additional attachment, the time spent by employés

THE HOWARD AUTOGRAPH TIME RECORDER.

on different jobs can be recorded on cards. This attachment does not in any way interfere with the ordinary time-keeping by weekly or daily sheets, but combines the two systems of time-keeping and cost-keeping.

The "Howard" autograph time recorder (see figure) is a small machine recently placed on the market for recording the time of employés in small departments, and for use where only a few hands are engaged. The employé signs his name in the space provided on the machine, when the exact time is printed opposite his signature with the distinction between a.m. and p.m.

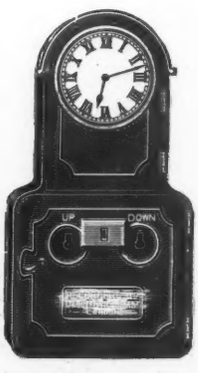
Kennedy Bending Machine Co. (186, 218).

Most electrical engineers are familiar with the Kennedy machine by this time, but those who desire a closer acquaintance with it will find it conveniently arranged, ready for their inspection and operation, on the company's stand. In pamphlets that they have issued, a description, with detailed line and half-tones, is given, together with directions for using the machine for bending various sections of metals.

International Time Recording Co. (183).

This firm are showing a number of their machines The International Rochester card time recorder, automatically records each employé's time for a full week on a separate card, all registrations being visible when made. The International card time recorder will do all that the Rochester recorder does, but in addition it shows prominently all late and irregular times of arrival and departure in red ink, distinct from the ordinary times, which are in blue. The arrangement is entirely automatic. The Bundy key time recorder is useful for obtaining an accurate record of arrival and departure of any number of employés as many times in the day as may be required.

The International autograph recorder is largely used for foremen and office staffs, and has been adopted in Government Departments. Against the signature of each employé, the day of the week, hour and minute is automatically printed. All late arrivals each day are



TRAMWAY TIME RECORDER. INTERNATIONAL AUTOGRAPH RECORDER.
INTERNATIONAL TIME RECORDERS.

automatically grouped together. There is no limit to the number of records obtainable. The tramway time recorder is in use by numerous tramway companies for recording the times at which cars pass certain points on the route, and it will take records of any number of cars. The times and descriptions of the cars are automatically recorded, and the "up" records are shown separately from the "down" records.

The New Gutta Percha Co., Ltd. (137a).

This exhibit consists of coils of wires and cables, insulated with the company's special insulating materials—known as Gutta Gentzsch and Pernax—suitable for electric lighting, transmission of power, telegraph, telephone and bell wires; sheets of the insulation are also shown.

Wires and cables insulated with gutta Gentzsch and Pernax have been supplied by this company to many of the English railway companies during the past five years, and their requirements have been so great (they practically taking the whole of the company's output) that it has only recently been possible to approach cable-users generally. The increased demand has made it necessary to extend the manufacturing plant at the company's works at Greenwich. This is being done as rapidly as possible, and the company will, within the next few weeks, be in a position to treble their output. Gutta Gentzsch and Pernax are insulating materials of high grade, of which the sole manufacturing rights for the United Kingdom and the Colonies are held by the company. They do not contain any gutta-percha whatever, but consist of the finest quality Para rubber, to which is added a wax-like material which is previously treated by a chemical process in order to give the mixture the desired physical and mechanical characteristics. As these installations do not undergo vulcanisation, it is not necessary to use tinned wires, and for the same reason a tape under the braid is not needed, the braiding and preservative compound being an adequate protection under all ordinary conditions, and the company is understood to expend the amount thus saved, on the quality of the insulation. If required, however, tinned wires and tape under the braid can be supplied at a small extra cost. The dielectric is of the same radial thickness as is adopted by the C.M.A. for their V.I.R. cables, and the insulation resistance compares favourably with vulcanised rubber, the prices being considerably cheaper.

Wires and cables insulated with these materials are well adapted for electric lighting, tramway work, and bell, telephone and telegraph purposes, and are so flexible that a seven-strand conductor can be bent backwards and forwards, until every wire is broken without damage to the insulation. It is also claimed that they will withstand, without deterioration, alternations of wet or dry, that they are not affected by atmospheric conditions, or many of the acids, and that they are particularly suitable for submarine work and other positions where salt is present. As stated above, the first users of the cables were railway companies, who are still large buyers, and, in addition, they are now being used by leading corporations and supply companies, tramway companies, the National Telephone Co. and many large contractors.

Howard Asphalt Troughing Co., Ltd. (229).

This firm exhibit their solid system of laying underground mains, in which the cables are laid in a trough manufactured from natural rock asphalt, and made continuous for the entire length of main by means of welded joints. The entire system is demonstrated by a number of samples showing the various stages of work to be carried out in the trench, and which may be briefly described as follows:—

The troughs are supplied in 4-ft. lengths, encased in sheet steel for their protection during transit. This sheeting rapidly rusts away in the ground, thus leaving the asphalt trough free to follow any ordinary subsidence of the soil without fear of cracking.

The lengths of trough are jointed by bringing the ends in contact with a hot iron, which softens them, until, by pressing together, they readily and firmly unite. The weld is dressed and

Howard Troughing System.

smoothed to the shape of the trough by a hot iron, and it is difficult to detect the exact locality of the joint after the work is finished.

The cables are laid in the bottom of the trough, being held apart by asphalt separators. No bridges are used on the Howard solid system.

Bitumen is first poured over the cables until they are just covered. After this has cooled, the sides and top edges of the trough are painted with tar, and the whole trough is then filled to overflowing with asphaltic concrete moulded to the shape of an arch by a hot iron.

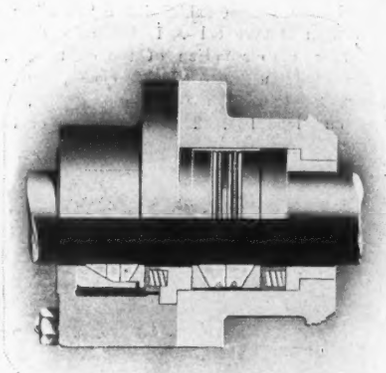
The feature which is brought out perhaps more than any other in the present exhibit is the extreme flexibility of the system—troughing being shown coiled in complete circles, as well as passed under and over drain pipes, &c.

The Auto-Controller and Switch Co. (214).

The company are showing "Fluxite" soldering paste, and practical demonstrations of its utility are being given daily.

The Combination Metallic Packing Co., Ltd. (25).

This company have fitted out their stall as an office. The articles shown are manufactured at Hillgate, Gateshead-on-Tyne. Several types of metallic packing for piston and slide rods are exhibited, also sectional models, which illustrate the working of the packing, whilst the advantages are clearly shown. The Case packings were originally designed and patented by the company, but some of the patent rights have since lapsed. They, however



use a special alloy, which is a trade secret, for the wearing segments which form a vital part of all packings. The "M" type is well known to most engineers in charge of electric lighting and power stations.

The types of metallic packing used for revolving rods and patent stop valves should interest most engineers. Amongst other specialities shown is the C.M.P. metal jointing rings, which make a "metal-to-metal" joint.

The Vincit Co., Ltd. (16).

This exhibitor is agent in Great Britain and Ireland for the Vienna Carborundum Works, and the speciality shown on this stand consists of carborundum resistance rods, which are made to the specification of clients for forming resistances from 10 to 200,000 ohms, which, we learn, are now very largely used. "Electrite" wheels, as used by many of the leading engineering firms throughout Great Britain, are shown. "Electrite" is made in electric furnaces in a similar manner to carborundum. It is extremely hard and also tough, a most necessary feature in an ideal abrasive. For precision grinding it has no equal, as it is undoubtedly a free cutting wheel, whilst it stands up to the work. It is recommended for working all classes of steel in plain, universal and cylindrical grinding machines, surface grinders, and for sharpening milling cutters, &c. Also for fettling cast and malleable-iron castings.

"Electrite" grain, when properly worked into bobs, is claimed to be far superior to emery and corundum.

Another class of goods here is paper and cloth disks for disk grinders. All the A quality disks are made by machinery, the abrasive material being coated on same very thickly and in spirals, thus ensuring rapidity of cut and smooth finish. Carborundum is represented by a pile of wheels from large to small. In the counter cases, various shapes of files and bricks in a variety of grains and powders are shown. In the centre case are exhibited a few samples of crude carborundum exactly as taken from the furnaces.

The No. 2 Birch grinder is exhibited on this stall, and a demonstration of the power of "Electrite" wheels for grinding steel is given on same.

The Aero Automatic Fire Alarm Co. (19).

The Aero fire alarm consists of a $\frac{1}{10}$-in. diameter copper tube, which is run through the building in suitable positions for it to be affected by heated air; both ends go to a switchboard, one being joined to a detector, which includes a flexible mica sheet carrying electrical contacts, and is provided with a permanent leak, and the other ending in a collapsible metal chamber with a push button for testing purposes. Owing to the leak the air pressure in the tube fluctuates with the ordinary pressures outside, but an extraordinary pressure rise, such as would be caused by dangerous heat near the tube, cannot be thus compensated, and as a result the mica diaphragm in the detector bulges out, closing the contacts and giving the alarm.

The principal claim appears to be the fact that the tube can run anywhere, and thus protect a building better than a number of scattered detectors as ordinarily employed; obviously it can also be made invisible, an advantage in buildings with architectural pretensions.

L. E. Wilson & Co. (18).

Messrs. L. E. Wilson & Co. are exhibiting the Thomson electric pocket lamp, which consists of an unspillable accumulator in a handsome nickel-plated case, and gives a useful and brilliant light for five to six hours. This lamp has been designed essentially for pocket use, and is fitted with a powerful lens reflector.

The glow lamp is of the Osram type. Amongst a number of useful accessories for use with the lamp, Messrs. Wilson have evolved a neat gaslighter, actuated by current derived from the accumulator.

The most novel feature of the exhibit is the "Fors" accumulator, a new departure in storage cells. It has been designed with a view to securing free circulation of the electrolyte, uniform action over the whole surface of the electrodes, and the ready escape of gases, together with very light weight, small size, high efficiency and long life. The construction of the cell is

"FORS" 40-AMPERE-HOUR ACCUMULATOR.

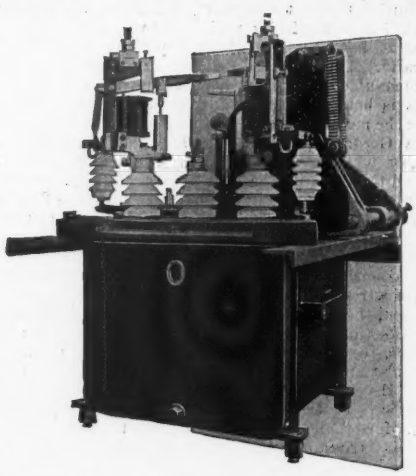
exceedingly simple; as usually made, it consists of a positive electrode in the shape of a fluted cylinder, placed inside a porous pot, which is closely surrounded by the negative electrode. The whole forms one unit, any number of which can be combined to increase the capacity of a cell, and which can be made also of various lengths and diameters for the same purpose. The porous separator ensures absolute freedom from short circuit due to the accumulation of sediment at the bottom of the cell, so that the large space usually left on this account is not required, and the volume of the cell is thus diminished. The ample support given by the circular shape to the electrodes enables very light grids for the active material to be used, and buckling is impossible. Local action is prevented by the porous pot, there being no possibility of leakage between the plates, and the cell therefore retains its charge indefinitely when not in active use. The cell can also be charged and discharged at high rates without injury. The following are the advantages claimed for the "Fors" accumulator:—Reduction of weight and space occupied; impossibility of short-circuiting; impossibility of plates buckling; capability of standing very rough treatment without injury; retention of charge indefinitely when not in active use; guaranteed output, 18 watt-hours per lb. of complete cell. The accumulator is of entirely British manufacture, and is made in various sizes, in celluloid and glass boxes. We understand that some important contracts for these cells are in course of negotiation. Our illustration shows a battery of 40 ampere-hours capacity at 4 volts, suitable for ignition or lighting, and measuring $6 \times 2\frac{3}{8} \times 4\frac{3}{4}$ in.

The Knowles porcelain lampholder, which is peculiarly adapted for use in situations where acid and alkali fumes exist, being constructed of a single piece of porcelain without any joint; the Laurie and Inglefield travelling light and the stretching pendant; and the Nodon patent electric valve for transforming alternating into continuous current—with all of which our readers are familiar—are also shown on this stand.

Union Electric Co., Ltd. (175, 231).

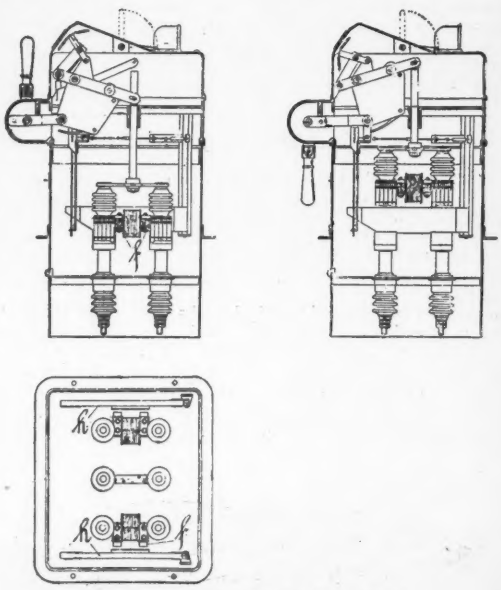
Among the Union switch exhibits will be found a H.T. motor switch panel, consisting of an oil break switch interlocked with a motor starter of the oil-bath pattern; the apparatus is ironclad and typical of what would be adopted for pressures up to 10,000 volts.

Alternating and direct-current distribution panels and several types of H.T. switch pillar are shown. As regards the latter, we illustrate a triple-pole 130-ampere switch for 10,000 volts, fitted



UNION 10,000-VOLT OIL-SWITCH.

with an adjustable overload release, having an indicating finger on the front of the pillar. The oil tank forms the base of the apparatus, the working gear being carried above it, and including small trip magnets *f*, which attract the armatures *h*, for effecting the release of the oil switch.



DETAILS OF THREE-PHASE OIL-SWITCH.

A distant-release attachment is provided, and indicators for showing the number of times an overload has occurred, though not of sufficient duration to operate the switch, also whether the time relay device requires rewinding.

The centre section of the pillar can be lifted out and the whole of the gear inspected without disconnecting any of the connections.

A variety of L.T. apparatus is shown, including various types of controllers, lever switches, &c.

J. W. Perkin (234).

This firm (late Beanland, Perkin & Co.) are showing there a complete range of their machine tools, including sensitive drilling machines, shaping machines in three styles, power hack saws, screwing machines, disk grinders, and drill grinders. For the first time they exhibit one of their new 18-in. disk grinders for general engineering works, with self-oiling bearings and other improvements. This has been put on the market as a handy machine for general workshops at a moderate price. Mr. Perkin is also showing in operation one of his steam turbine separators for oil and waste reclaiming, and is giving demonstrations at intervals of its capabilities.

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CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—November 20th. The City Council requires tenders for the supply and erection, complete, of a refuse destructor, electric lighting plant for the same, &c. Particulars may be obtained from the Agent-General for South Australia, 1, Crosby Square, Bishopsgate Street Within, E.C.

Melbourne.—The Postmaster-General of the Commonwealth requires tenders for the supply and erection of installations for wireless telegraphy at the following places:—Launceston; King Island (Bass Straits); Flinders Island (Furneaux group); Melbourne. See "Official Notices" September 18th.

Tasmania.—March 15th, 1909. Postmaster-General. Telephone switchboard, common-battery system and apparatus for use at subscribers' premises, Launceston. Specifications and particulars of general conditions can be inspected at the offices of the Electrical Review.

Victoria.—Three sets of testing instruments, for the P.M.G. See "Official Notices" to-day.

Belgium.—The municipal authorities of Louvain (province of Liége) have invited tenders for the concession for the public and private electric lighting of the town.

Bury.—October 23rd. Electric lighting of the East Ward Council School for the Corporation. See "Official Notices" October 9th.

Cape Colony.—November 18th. Dry cells in quantities from July 1st, 1909, to June 30th, 1910, for the Government. Information from Controller of Stores, G.P.O., Cape Town, to whom six sample cells should be sent. All tenders must be on printed forms supplied for the purpose. A fuller notice appeared in the *Board of Trade Journal* last week.

Constantinople.—The Post and Telegraph Department requires tenders for 8,500 miles 4-mm. steel wire, 15,000 Leclanché insulators, and 1,360 other insulators. A deposit of 10 per cent. is to be made by a local agent.

Egypt.—October 29th. The Ministry of the Interior wants tenders for the installation of electric lighting in the town of Zagazig, in accordance with specifications and plans that may be inspected at the offices of the above Ministry at Cairo.

Epsom.—October 23rd. Storage battery for the U.D.C. See "Official Notices" to-day.

Germany.—The municipal authorities of Liebstadt, East Prussia, are about to invite tenders for the establishment of a central electric lighting station in the town, at an estimated cost of £40,000.

G.W. Railway.—October 20th and November 10th. Stores for the G.W. Railway. See "Official Notices" October 2nd.

London.—October 27th. Twelve water-tube boilers with mechanical stokers, superheaters, &c., for the L.C.C. See "Official Notices" October 2nd.

Camberwell.—The Board of Guardians is inviting quotations for a suitable method of ventilation in the committee room.

Manchester.—October 28th. High-pressure steam and feed pipes, valves and supports, for the Corporation. See "Official Notices" to-day.

Portsmouth.—October 21st. Reconstruction of a turbo-generator for the Corporation. See "Official Notices" October 9th.

Rochdale.—The second paragraph appearing under this heading in our last issue should have been headed *Salford*, as in our issue of October 2nd.

Salford.—October 26th. Electric light installation at the Seedley Baths, for the T.C. (Deposit 10s. 6d.) Mangnall and Littlewood, architects, 42, Spring Gardens, Manchester.

November 2nd.—Cooling towers, tanks, &c., for the Corporation. See "Official Notices" to-day.

Uruguay.—San Eugenio.—November 2nd. Tenders are invited for the building and equipment of an electric central station in this city. Address, Direccion Jeneral de los Ferrocariles del Estado. The State Railway likewise contemplates laying down three 300-kw. generators at Santiago. Particulars from the Oficina Tecnica of the railway.

CLOSED.

Accrington.—With regard to the tenders for coal for the electricity department, the T.C. has resolved, after considering quotations, that for the present the electrical engineer continue to order coal from Altham Colliery Co. on current terms. For the supply of cylinder oil it was resolved that the tender submitted by Messrs. Belliss & Morcom, Ltd., be accepted. For crank oil that of Messrs. John Peters & Co. was lowest, and it was accepted for a period of 12 months.

The T.C. is purchasing a new low-pressure cylinder cover, to replace one recently damaged, from Messrs. Belliss & Morcom. A sub-committee is to meet to discuss proposed extensions and alterations.

Australia.—Adelaide (S.A.).—*Australasian Hardware and Machinery* says that the lowest tender received by the Municipal Tramways Trust for the erection of the car depôt, offices and workshops at Hackney was that of Smith, Timms & Co., the contractors for the permanent way. The amount was £82,350, and the tender having been accepted, a beginning is being made with the work.

Victoria.—The same exchange says that for the electric lighting of Camperdown the following tenders were accepted early in the month:—

R. Hornsby & Sons.—Suction gas plant, £1,126.
A. W. Wood.—Dynamo and electrical appliances, £1,575.
A. Kelly.—Poles, struts and stay poles, £188 10s.
British Insulated and Helsby Cables, Ltd.—Cables and wires, £350.

Brisbane.—Postmaster-General's Department material:—

Humphreys & Richardson.—36 battery boxes, at 5s. 6d. each; 75 ditto, at 5s. 2d. each; 70 single-wing platforms, at £3 2s. each.
Brisbane Electrical Co.—60 four-point double protectors, at 10s. 5d. each; 70,000 brown paper sleeves, at 2s. per 100.
Paul & Grey, Ltd.—39 manhole frames and covers, at £1 2s. 10d. each; 147 ditto, at £1 10s. 9d. each; 170 cast-iron potheads, 17 at 5s. each, 44 at 6s. each, 82 at 7s. each, 20 at 13s. 3d. each.
Smith & Atkinson.—Making 1,500 Daniell coppers, at 3s. 6d. per 100; making 12,000 Meidinger leads, at 4s. 6d. per 100; making 3,000 Daniell pockets, at 9s. per 100; making 6,000 Daniell zincs, at 8s. per 100; making 16,000 Meidinger zincs, at 7s. 3d. per 100; making 1,000 large rolled zincs, at 29s. 2d. per 100.

Burnley.—The T.C. has accepted the following tenders for the supply of new plant required at the electricity works:—

E. Green & Sons.—Economisers.
J. P. Hall & Sons.—Boiler feed pump.
Sugden, Ltd.—Two superheaters.
Stewart & Lloyds, Ltd.—Steel steam piping and valves.
Yates & Thom, Ltd.—Two Lancashire boilers.
British Westinghouse Co.—750-kw. switchboard.

Cardiff.—The T.C. has placed the following orders for coal for the E.L. and Tramways Departments:—

The Tredegar Coal, &c., Co.—Roath Station, 1,000-1,200 tons of washed peas, at 11s. 3d. per ton delivered; Canton Station, 200-250 tons of peas, at 11s. 3d. per ton delivered; and 3,500 tons of same coal, for delivery either at Canton or Roath, at 10s. 9d. per ton net.
W. T. Beaven.—Roath Station, 300 tons of "Ocean" steam washed peanuts, at 10s. 9d. per ton net, delivered at Roath electrical power station siding.

Cordoba.—The *Review of the River Plate* states that the Ministry of Public Works of the Cordoba Provincial Government has received nine tenders in response to its inquiry for the installation of a new electric power house, to comprise two steam sets of 500 h.p. each, with their corresponding boilers and switch-gear. The necessity for this new power station has arisen through the inability of the existing company to meet the demands of consumers, through the lack of sufficient water in the Dique San Roque. The following were the tenders received:—

	$ o/s.
Ludke, Sajoux & Cia.	102,650.00
Hopkins & Cardom	96,600.00
Cia. Industrial de Electricidad del Rio de la Plata	93,360.00
Agar, Cross & Cia.	86,600.00
Colson, Brookhouse & Pyne	82,541.00
G. Scherb & Cia.	81,470.00
Lindenberg, Nellen & Cia.	79,560.00
Parcus & Cia.	79,400.00
Blanchetti Hnos. (incomplete)	77,000.00

Dawley.—Messrs. Kynoch, Ltd., have secured a contract for the supply of a pumping plant to the District Council. The plant consists of two sets of Kynoch gas engines and suction gas plants, and Mather & Platt turbine pumps. The consulting engineers for the work are Messrs. Willcox & Raikes.

Glasgow.—The T.C. Electricity Committee has accepted the offer of the British Westinghouse Co. for two rotary converters with transformers and spares for the sum of £851.

Johannesburg.—At a recent meeting of the T.C. the tender of Messrs. J. Cartner & Co. for the extension of the tramways to Orange Grove, at £3,621, was recommended for acceptance.

London.—Chelsea.—The B.C. has accepted the quotation of Wright Bros. & Co. for the supply and fixing of 87 electric light fittings for the Town Hall extension, at £124. The acceptance is subject to the approval of the L.C.C. as regards the manner of suspending the fittings in the licensed portion of the building.

West Ham.—The T.C. received the following tenders for the supply and fixing of transformers, &c., at the Balaam-street Baths, to reduce the voltage to 25 volts to permit of the use of 10, 16 and 25-c.p. Osram lamps:—

J. T. Halsey	(accepted)	£52 10 6	(4)
W. J. Woodward		58 0 0	(1)
W. Simmons		60 16 0	(4)
Electricity Department		71 15 0	(1)

Transformers, similar to the above, for effecting economy in the lighting of underground conveniences:—

J. T. Halsey	(accepted)	£14 18 6
Vulcan Electric Co.		18 5 0
Electricity Department		6 6

L.C.C.—The following tenders have been considered by the Highways Committee of the L.C.C. :—

Supply of Slot and Conductor Rails.

P. & W. MacLellan	(recommended)	£15,193
Frodingham Iron and Steel Co.		15,611
Walter Scott, Ltd.		16,559
Edward Le Bas	(Belgian slot rails only)	14,197
Aciéries d'Angleur	(slot rails only)	12,300
Engineer's estimate		15,857

Track Rails and Fastenings.

Aciéries d'Angleur	(Belgian rails)	£21,439
Edward Le Bas	(Belgian rails)	22,080
Walter Scott, Ltd.	(recommended)	24,263
Bolckow, Vaughan & Co.		24,453
Engineer's estimate		24,773

Supply of Wiring Material for Second Portion of Greenwich Station.

Edison & Swan Co.	(accepted)	£2,260
Pinching & Walton		2,287
Johnson & Phillips		2,307
Baxter & Caunter		2,356
G. E. Taylor & Co.		2,357
Henley's Telegraph Works Co.		2,385
General Electric Co.		2,423
British Insulated and Helsby Cables		2,469
Western Electric Co.		2,478
Siemens Bros. & Co.		2,534
W. T. Glover & Co.		2,607
Nettlefold & Son		2,634
Callender's Cable Co.		2,668
Charles Mackintosh & Co.	(incomplete tender)	1,351
James Littauer	,, ,,	896
W. Rickard, Ltd. ..	,, ,,	664
Simplex Conduits, Ltd.	,, ,,	369

Wiring and Fitting of Central Car Repair Depôt.

G. E. Taylor & Co.	(accepted)	£1,278
Tredegar & Co.		1,319
Pinching & Walton		1,325
W. Mackie & Co.		1,500
Lund Bros. & Co.		1,628
Charles Pullan		1,684
W. E. King		1,904

High and Low-Tension Switchgear for Sub-Stations.

Johnson & Phillips	(accepted)	£3,807
Spagnoletti, Ltd.		4,019
Whipp & Bourne		4,119
Switchgear Co.		4,229
British Westinghouse Co.		4,301
Ferranti, Ltd.		4,553
General Electric Co.		5,105
Union Electric Co.		5,6.5

Supply of 200,600 Stoneware Ducts.

Stanley Bros.	(accepted)	£2,250
	(subject to 2½ per cent. discount for monthly cash payments)	
Doulton & Co.		2,250
Robinson & Dowler		2,250
H. R. Mansfield		2,267
Hosea Tugby & Co.		2,267
T. Wragg & Sons		2,400
Gibbs & Canning		2,450
Donington Sanitary Pipe Co.		2,500
Ensor & Co.		2,500
North Bitchburn Coal Co.		2,800
Sutton & Co.		2,900
James Stiff & Sons	(100,000 ducts)	1,170
George Skey & Co.	(75,000 ducts)	923
Oates & Green	(10,000 ducts)	250

Laying Stoneware Cable Ducts.

John Mowlem & Co.	(accepted)	£17,476
Reid Bros.		17,498
Dick, Kerr & Co.		17,904
W. Muirhead & Co.		18,211
J. A. Ewart		18,589

Seven Motor-Generators for Sub-Stations.

British Westinghouse Co.	(accepted)	£11,682
Phœnix Dynamo Manufacturing Co.		12,077
Dick, Kerr & Co.		12,284
General Electric Co.		12,282
Union Electric Co.		12,541
Siemens Bros. Dynamo Works		13,808
Electric Construction Co.		16,473

Overhead Travelling Hand Crane for Sub-Station.

John Smith (Keighley), Ltd.	(accepted)	£190
James Spencer & Co.		190
Alexander Jack & Co.		199
J. Carrick & Sons		208
Marshall, Fleming & Co.		219
Applebys, Ltd.		264
John Williams & Sons (Cardiff), Ltd.		270
Rowland Priest		275
Willcocks & Son		295

Six Electric Transport Vehicles for Stores.

Mountain & Gibson	(recommended)	£3,230
Dick, Kerr & Co.		3,290
United Electric Car Co.		3,414
Hurst, Nelson & Co.		3,439
Gloucester Railway Carriage Co.		3,774

Three Lifts for Central Car Depôt.

Medway's Safety Lift Co.	(accepted)	£608
Easton Lift Co.		882
Archibald Smith & Stevens		920
E. Waygood & Co.		925
A. W. Penrose & Co.		1,084

Fifty Sets of Indicator Box Fittings for Electric Cars.

Hurst, Nelson & Co. ..	(recommended)	£150 0 0
Hoskins & Sewell		157 10 0 less 2½ per cent.
Player & Mitchell		160 8 0 less 2½ ,,
United Electric Car Co.		567 11 4
Howarth & Houson (not to specification)		70 0 0 less 5 ,,

Arc Lamps for Westminster Bridge.

G. E. Taylor & Co.	(accepted)	£331
Foote & Milne		362
Henley's Telegraph Works Co.		535
W. T. Glover & Co.		587
Callender's Cable Co.		691

Rugby.—The U.D.C. Public Library Committee has accepted the tender of Mr. Marsh, Castle Street, Rugby, for alterations and additions to the E.L. installation at the library, and the substitution of B.T.H. tungsten metallic filament lamps of 20 c.p. for those at present in use.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of Messrs. Daniel Adamson & Co., of Dukinfield, for the supply of two boilers.

Taunton.—The Electricity Committee has accepted the tender of Messrs. Easton & Bessemer, of Taunton, for a compound double-acting engine for the electric light works, at £361.

Worksop.—The U.D.C. has accepted the tender of W. T. Henley's Telegraph Works Co. for 500 yards of cable, at £74.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDEEN.—Proposed sanatorium at Oldmill Poorhouse. Clerk to Parish Council, Aberdeen.

(Sandilands).—Enlargement of Sandilands Chemical Works for J. Miller & Co.

ADLINGTON (Lancs.).—New Church Schools. Ormrod & Pomeroy, architects, Bolton.

AMMANFORD.—Workmen's Home for Rees Owen, Pantyffynon. D. Thomas, architect, Ammanford.

ARDINGLY (Sussex).—New schoolrooms, &c., in connection with St. Saviour's (£6,000).

ARLINGTON.—New day schools. Ormrod & Pomeroy, architects, Bolton.

ASHFORD (Kent).—House, Royd Road, Willesborough, for H. Bradshaw. D. Godden & Son, builders, Ham Street, Orlestone, Ashford.

ASTON.—New laundry for the Board of Guardians.

BANGOR.—Enlargement of the Bangor Normal College (£3,000). R. Ll. Jones, architect to the Carnarvonshire Education Committee, Carnarvon.

BARNSTAPLE.—Dwelling house in George Street; H. Burgess, Bear Street, Barnstaple. Two dwelling houses in Charles Street; E. Karslake, Bear Street, Barnstaple.

BEDLINGTON.—Sinking new collieries (just commenced). Bedlington Coal Co.

BEXHILL.—Bungalow residence, Popp's Farm; F. W. Green, owner; J. B. Wall, architect. Workshop, Paris House, Devonshire Road, for B. W. Willett; A. A. Oakden, architect.

BIRMINGHAM.—Laying out estate of 50 acres, off Ravenshurst Road, Harborne, for workmen's dwellings, for the Harborne Tenants, Ltd. Martin & Martin, architects.

BLACKPOOL.—New shop premises on Promenade. Liptons, Ltd.

BLAIRGOWRIE.—Rebuilding part of Ericht Linen Works. Johnston & Baxter, architects, Dundee.

BOLTON.—Proposed alterations at Victoria Hall, Knowsley Street. New consumptive pavilion at Rumworth; borough engineer. Sixteen houses at Astley Bridge, for W. H. Orrell.

BOOTHSTOWN (near Manchester).—Five houses, Leigh Road. W. Berry.

BOSTON.—Houses, Orchard Street, for H. Kirton; office, High Street, for Messrs. Rank, Ltd., millers; alterations, White Hart Hotel, for Mr. Mather; alterations, Railway Tavern, for Soulby, Sons and Winch, Ltd., brewers, West Street, Boston.

BRAUNTON (Devon).—Pair of semi-detached villas at Vellator, for E. J. Slee; H. W. Weir, architect, 32, Greenclose Road. Ilfracombe. Two dwelling houses in Old Barnstaple Road; W. Hancock, Chapel Street, Braunton.

BREDBURY (near Stockport).—Houses, Pinfold Lane, Romiley, for Mr. Timpany; shop, &c., for C. Linney, Toll Bar; houses, Guywood Lane, Romiley, for W. Williamson.

BRENTWOOD.—Extension of the Essex County Lunatic Asylum. F. Whitmore, architect, 73, Duke Street, Chelmsford.

BRIGHTON.—Ice factory and cold stores, for the Linde British Refrigerator Co., Ltd., Lower Shadwell, London, E.; proposed artisans' dwellings on the site of St. Mary's School, Park Hill (£3,090).

BURNLEY.—New theatre on site of present Empire Music Hall; B. Crewe, architect, 75, Shaftesbury Avenue, W. New ambulance hall (£3,000).

BUXTON.—Billiard and smoke rooms at the Balmoral Boarding House.

CANTERBURY.—Lodge residence at the City Asylum, for the T.C.

CATERHAM.—Meter house for Metropolitan Asylums Board. W. T. Hatch, engineer to the Board, Victoria Embankment, E.C.

CHATHAM.—Proposed new elementary school in Luton Road (1,000 children). H. P. Mann, clerk to the Chatham Local Education Authority.

CHEADLE HULME (near Stockport).—Houses, Ack Lane, for J. H. Clibran; Woodfield Road, for P. S. A. Unsworth; Ramillies Avenue, for J. Livesay; Mellor Street, for Russell & Co.; Grove Lane, for H. Ramsbottom.

CHELMSFORD.—Houses, Burgess Well Road, for James I. Taylor; Church Street, Moulsham, for G. T. Bedingfield; Primrose Hill, for Arthur Cowler.

CHIPPENHAM.—Business premises for the Co-operative Society; Mr. Harris, architect, Co-operative Wholesale Society, Manchester. Conservative Club, in Foghamshire; W. Osborn, architect. New schoolrooms at Christian Malford.

CHORLEY.—Houses, Chorley Old Road, Whittle-le-Woods, for Matthias Karfoot; Lightbourne Terrace, Coppull, for Wm. Riding.

CLACTON-ON-SEA.—Houses, Oxford Road, for Z. Fairclough; Beatrice Road and Jackson Road, for B. Burch; additions to Ascham College, for A. S. Wilson.

CLIFDEN (Co. Galway).—New Assembly Hall and reading rooms. R. M. Butler, architect.

COATBRIDGE.—Prospective rebuilding, after fire, of the Coatbridge Pipeclay Works, Stoborose Street, for J. Craven.

CORNSAY COLLIERY (Durham).—New school and alterations to existing one. County Education Architect, Shire Hall, Durham.

CROYDON.—Twenty-four houses, Headcarn Road, for G. W. Flitton, Gonville Road. Two houses; A. Broad, 22, George Street, Croydon. Large shop and dwelling house, North End; Berney & Son, architects, 104, George Street, Croydon.

DERBY.—New Baptist Church at Kilburn. Suggested structural alterations at Workhouse; Board of Guardians. Covered market for the T.C. (£1,760).

DONCASTER.—Brown Cow Inn, French Gate, to be rebuilt by the T.C.

DUBLIN.—Additions and alterations at the General Post Office. H. Williams, secretary, Office of Public Works, Dublin.

DUDLEY.—New buildings and alterations and additions to the Fire Station, Priory Street. J. Gammage, borough surveyor, Town Hall, Dudley.

DUNDEE.—Skating rink. H. & F. Thomson, Dundee.

DUNGARVAN (Co. Waterford).—Improvements to Town Hall.

EBBW VALE.—Street of shops, Bethcar Street. Messrs. Gale, builders.

EDINBURGH (Colinton).—Cavalry barracks at Redford Farm for the War Office.

EXETER.—New Hippodrome in High Street, for F. Karno & A. H. Edwards, proprietors, New Hippodrome, Peterborough. B. Crewe, architect, 75, Shaftesbury Avenue, W.

FARNWORTH (near Bolton).—Electrical installation for power and lighting for the Farnworth-with-Kearsley Co-operative Society.

FENCE HOUSES (Co. Durham).—Houses, Station Avenue, for A. Grieves; house and shop for W. Smith.

FLEETWOOD.—Twelve houses in Carr Road and Chaucer Road. J. England.

FOLKESTONE.—Detached house, Turketel Road, for F. Nicholls; A. Bromley, architect, Cheriton Place, Folkestone. Almshouses, corner of Cheriton and Surrenden Roads, for the trustees of the late J. Bowley; A. Bromley, architect. Additions to 87, Earl's Avenue, for G. H. Hayne; O. Marx, architect and builder.

(Cheriton).—Shop and dwelling house in Church Street, for W. H. Arger, 8, Bonsor Road, Folkestone.

FROME.—Enlargement of the Isolation Hospital for the Urban District Council (£300).

GILLINGHAM.—Electric cranes to be placed on the wharves by the T.C. New buildings in Canterbury Street, for Mr. Thorne.

GLASGOW.—Reconstruction of Milngavie Parish Church (£5,000); Rev. Mr. Dickie, Milngavie, Glasgow. Prospective rebuilding, after fire, of saw mills for Robinson, Dunn & Co. Enlargement and restoration of New Kilpatrick Church (£5,000); Rev. J. H. Dickie.

GREAT CROSBY (near Liverpool).—Detached villa, Coronation Drive, for Lawson & Rimmer; three pairs of houses, Sherwood Road, for Wm. Wright.

HALSTEAD (near Sevenoaks).—Pair of semi-detached houses, Old London Road, Knockholt, for T. White.

HAWICK (N.B.).—Public swimming baths at the Exchange Hall (£4,000). Town Council.

HERTFORD.—Shop and stables at Knebworth, for Mr. Dearman; houses, Milestone Road, Knebworth, for G. Rayment; Clay End, Walkern, for Miss Cotton-Browne; Pondcroft Road, Datchworth, for Mr. Darby.

HODDESDON.—New County Schools at Rye Park (£2,355).

HORNSEA (near Hull).—Five houses and shop, Cliff Road, for Mr. Adamson; pair of villas, Carlton Avenue, for E. W. Piercey; six houses, Carrington Avenue, for Mr. Crossland.

HOUGHTON-LE-SPRING (Co. Durham).—Houses, Paddock Stile, Philadelphia, for Messrs. Balmer.

HYTHE.—Two houses in Earlsfield Road, for S. Wise; bungalow at Stanford, for Mr. Franks; houses at Saltwood, for Mr. Chitty and Mr. Court.

IPSWICH.—Extensive alterations to premises for E. Beard, furnisher, Princes Street.

IRLAM (near Manchester).—Two villas, Liverpool Road, for Herbert Grundy, Irlam.

KEARSLEY (near Bolton).—New public offices. Surveyor, Council Offices, Kearsley, Bolton.

KIRKBY-IN-ASHFIELD (Notts.).—Houses, Fox Street, for Mr. Conway; Southwell Road, for Coleman & Blackburn; Unity Street, for Mr. Gilbert; Hartley Road, for Mr. Herbert.

LAINDON (Essex).—Additions and alterations at the Laindon Branch Workhouse, for the Poplar Board of Guardians. J. & W. Clarkson, architects, 133, High Street, Poplar, E.

LEEDS.—Extension of St. Clement's Sunday Schools, new men's club, &c. Sydney D. Kitson, architect, Leeds.

Firemen's dwellings for the T.C. P. Robinson, architect, 53, Albion Street, Leeds.

LEICESTER.—Six cottages for the T.C., Colton Street. E. G. Mawbey, Borough Surveyor, Town Hall, Leicester.

LEOMINSTER.—Garage, Etnam Street, for S. Leach; villas, Etnam Street, for W. Pounds.

LIMPSFIELD (Surrey).—House, St. Andrew's Road, for A. L. Foster.

LINCOLN.—Houses, Rasen Lane, for H. Hardwick; Monk's Road, for A. E. Parkinson; mill Road, for C. Dowse.

LINGFIELD (Surrey).—New epileptic home, for the Trustees of the Farm Colony; houses, Moor Lane, for R. C. Head, builder; Chartham Park, for Col. Margery; Baldwin's Hill, for H. C. Nightingale; alterations and additions to Yew Lodge, for S. Lawrence; alterations to The Anchorage, Dorman's Park, for G. Stirling.

LITHERLAND (near Liverpool).—Mortuary for the U.D.C. Thos. Spencer, builder, Aintree.

LITTLE HULTON.—New central Co-operative premises; Henderson & Brown, architects, Bolton. Structural alterations at Royal Oak Inn. Cornbrook Brewery Co., Manchester.

LITTLE MONGEHAM (near Deal).—Bungalow residence, for Mr. Ives, Hatfield Nursery, Sheerness.

LIVERSEDGE.—Warehouse extensions at Stanley Mills, Littletown, for J. W. and F. H. Priestley, Ltd.

LLWYNYPIA (Glam.).—Two houses for the Glamorgan Coal Co., Ltd.; E.G.C. Down, architect, 31, High Street, Cardiff.

LONDON (Finchley).—Five houses; Holliday & Son, builders, 74 and 76, High Road, North Finchley, N. Additions to St. Michael's Church, Hendon Lane. Four houses; A. E. Denham, builder, Manor Park Road, East Finchley. Sunday School building in connection with Wesleyan Church, High Road, East Finchley.

(Hammersmith, W.).—Formation of new street on the Old Oak Lodge Estate. M. J. Allen, contractor, 111, Adelaide Road, Shepherd's Bush.

(Wandsworth, S.W.).—Seventy houses, Mandrake Road and Glenburnie Road; W. C. Poole, architect, 62, Belleville Road, Wandsworth Common, S.W. House, Chartfield Avenue, Putney; J. C. Radford, architect, 223, Upper Richmond Road, Putney.

(Greenwich, S.E.).—Charlton Congregational Church; G. Parker, 124, Sumner Road, Peckham. Sixteen houses in Church Street and King William Street; Capt. W. Warburton, R.E., 95, Park Row, Greenwich, S.E.

LONDON (Strand, W.C.).—Extension of the Royal Courts of Justice. Sir H. Tanner, architect, H.M. Office of Works, Storey's Gate, London, S.W.

(Silvertown, E.).—Store at H. Tate & Son's sugar refinery; store and machine workshop, at R. Moreland & Son's premises, Bradfield Road.

(Canning Town, E.).—New offices and store for City Glass Bottle Co., Ltd., St. John's Road; alterations Royal Albert Music Hall; J. O. Farrer, architect, 2, Coleman Street, E.C.

(Barking Road, E.).—Alterations and additions, Mansfield House Men's Club. Frank Hamlett, builder, Barking Road, E.

(Stratford, E.).—Match factory. F. L. Forge, architect, 23, Martin's Lane, E.C.

(Battersea, S.W.).—Workshop for electrical engineers' works, at Ingate Place, Queen's Road. Macey & Sons, Ltd., builders, 24, Essex Street, Strand, W.C.

(Park Lane, W.).—Rebuilding mansion in Tilney Street and Deanery Street. T. Rider & Son, builders, 181, Union Street, Southwark, S.E.

(Charing Cross).—Altering 448, Strand (late post office) for branch of London and South-Western Bank, 170, Fenchurch Street, E.C.

(Edmonton, N.).—Warehouse in Angel Road for Stavers & Stavers, joinery manufacturers, 158, Leadenhall Street, E.C. 30 houses, Bagshot Road; F. Bethell, architect, 23, Queen Anne Place, Enfield.

(Tower Bridge, S.E.).—New warehouse (£2,760). A. W. Osborne, architect, 90-91, Queen Street, Cheapside, E.C.

(Victoria Docks, E.).—Prospective rebuilding after fire of electrically-equipped receiving house for J. Rank, Ltd., flour millers, Baltic House, 27, Leadenhall Street, E.C.

(Westminster).—Building upon site of 7, Princes Street. H. C. Clarke, architect, 63, Bishopsgate Street Within, E.C.

(Dulwich, S.E.).—House, Alleyn Park. Perry & Co., builders, Tredegar Works, Bow, E.

(Hammersmith, W.).—Additions, Askew Arms public house, Uxbridge Road. W. Bradford & Sons, architects, 12, Regent Street, W.

(Battersea, S.W.).—Workshop at rear of premises of Carbo-Welding Syndicate, Ltd., 49, Battersea Park Road.

(Paddington, South).—Additions at rear of 114A, Westbourne Grove. G. A. Sexton, architect, 42, High Road, Hampstead, N.W.

(W.C.).—Re-erection of 5, 6 and 7, Spur Street, Leicester Square. Taperell & Haase, surveyors, 9, John Street, Adelphi, W.C.

(E.C.).—Alterations to 29 and 30, Cock Lane, Snow Hill. Ogden, Sons & Olley, house estate agents, 4, High Street, Wimbledon.

(Finsbury, E.C.).—Alterations, &c., at "The Duke of York" public house. W. Bradford & Sons, architects, 12, Regent Street, W.

(Hendon, N.W.).—New factory (£1,800). Meakin, Archer and Stoneham, surveyors, 11, Clement's Lane, E.C.; A. J. Staines and Co., builders, 154, Great Tichfield Street, Oxford Street, W.

(Ealing, W.).—Secondary school and Technical Institute, Middlesex Education Committee.

LOWESTOFT.—Two houses, Kensington Road; Geo. Skippen, builder, Lowestoft. Two houses and shop, Cliff Road; E. Graveling, builder, South Lowestoft. Four houses, Rochester Road; J. J. Colby, South Lowestoft. Three houses, Royal Terrace; Royal Estate trustees, Lowestoft. Four houses, Beccles Road; W. Beaumont, Lowestoft.

MACCLESFIELD.—Proposed alterations at the Infirm Hospital. Whittaker and Bradburn, architects.

MALVERN.—Residence in Mathon Road, West Malvern, for A. G. Lewis; T. W. Holds, architect. House, Old Hollow, for C. Lane.

MANCHESTER.—School for Epileptics at Warford. Manchester Education Committee.

MARPLE.—Twenty semi-detached houses, Marple Bridge, for Thos. Hoe; house and shop, High Lane, for J. W. Booth.

MELKSHAM (Wilts).—Corn and Meal Stores, Church Street, for T. A. Kelson.

MELLOR.—Bungalow residence, for Mr. Dewhurst; house, Longhurst Lane, for Mr. Grange.

MELTON MOWBRAY.—Houses, Stafford Avenue, for Ernest Clarke.

MIDDLESBROUGH.—Alterations and additions to premises, for the Tees Pilotage Commissioners. R. Lofthouse & Sons, architects, 129, Albert Road, Middlesbrough.

MIDDLEWICH.—Houses, West Street, for Birchall Bros., builders, Darlington Street.

MONK BRETTON (near Barnsley).—Ten houses at Klondyke, for W. Bird.

MIRFIELD.—E.L. to be installed at the College of the Resurrection.

MONTROSE.—Proposed public hall and library at St. Cyrus.

MORLEY.—Additions to Glen Mills, for Albert Glover. T. A. Buttery, architect, Exchange Buildings, Queen Street, Morley.

NANTWICH (Wrenbury).—New factory for the Trufood Co., Ltd. (£3,000 to £4,000). G. D. Dennis, architect, London.

NEWBRIDGE (Mon.).—Extensions and alterations at Tynewydd Council School. C. Dauncey, secretary, Monmouthshire Education Committee, County Council Offices, Newport, Mon.

NEWQUAY (Cornwall).—Villa residence, Headland, for B. Greatrex, London. H. E. Farmer, architect, Walsall; Geo. Miners and Son, builders, Marazion.

New church (£10,000).

NORWICH.—Proposed extensive additions to the Norfolk and Norwich Hospital (£45,000). E. T. Boardman, architect, Town Close House, Norwich.

OLNEY (Bucks.).—New schools for Cowper Congregational Church (£750); Dawes & Hart, builders, Olney. Houses, Newton Street, for F. Dawes; Weston Road, for T. Wright.

OSWESTRY.—New Sunday schools in connection with the English Baptist Church. W. J. Oliver, architect, 1, Darlington Street, Wolverhampton.

OXFORD.—New church at Summertown (£7,865). Wooldridge & Simpson builders.

OXTED (Surrey).—Houses, Chichester Road, for Cruttenden & Son; Mill Lane, for W. Payne.

PERRANWELL (Cornwall).—Alterations and additions to residence. A. J. Cornelius, architect, Truro.

PERTH.—Proposed temporary public hall; Mr. McKillon, Burgh Surveyor. Store for J. Gardiner, grain merchant, High Street, Perth. Villa in Spens Crescent for J. Christie, cycle agent, Canal Crescent.

PONTYPRIDD.—Nine houses for D. R. Lewis; A. O. Evans, Williams and Evans, architects, Pontypridd. Two houses for Geo. Meats; Lewis & Morgan, architects, Pontypridd. Additions to Methodist Chapel, Cilfynydd; P. Jones, architect, Cilfynydd. Twenty-eight houses; Gibson, Parry & Williams, architects, Pontypridd. New business premises; A. Roberts, architect. Church Street, Pontypridd. Four houses for S. Bennett; A. O. Evans, Williams & Evans, architects, Pontypridd. Three houses; A. O. Evans, Williams & Evans, architects, Pontypridd. Nine houses for F. W. Oliver; A. O. Evans, Williams & Evans, architects, Pontypridd. Two houses for C. F. Oliver; A. O. Evans, Williams & Evans, architects, Pontypridd.

PICKERING.—New Roman Catholic Church and School, on Potter's Hill; five houses, Middleton Road, H. Boulton, builder.

PORTSMOUTH.—Covered yard for Hargrove & Co., 18, King Street; B. Salter. House, Festing Road, for Sir F. L. J. Barrow; J. Croad. Two houses, Walmer Road; J. R. Jones. Houses and stable, Ophir Road; W. Mitchell. Houses, Bowler Avenue; T. Bowler. Houses, Belgravia Road; E. G. Briggs.

PREESALL (near FLEETWOOD).—Lighting at Knott End Landing Stage. Preesall District Council.

PRESTON.—Wesleyan Church and Schools (£4,000). E. J. Andrew, architect, 30, Winckley Square, Preston.

PULBOROUGH.—Public Hall under consideration.

QUORN.—Villa residence, Chaveney Road, for G. F. Farnham.

RAMSBOTTOM.—New weaving shed. Chatterton Weaving Co., Ltd.

RICHMOND-ON-THAMES.—Beehive Inn, Lower Richmond Road, to be rebuilt. Watney, Coombe & Reid, Ltd., Stag Brewery, Pimlico, owners.

RICKMANSWORTH.—New Schools at Mill End, for the C.C. (£1,085). G. Jaggard, builder, Bushey.

RIPPLE (near DOVER).—Two detached villas, for H. Jenkins.

ROCHDALE.—Branch Swimming Baths at Castleton Moor. Wallis & Bowden, architects, Rochdale.

ROMFORD.—New Parish Hall for St. Edward's parish (£1,300).

RINGWOOD.—House at Poulner, for Mr. Alexander.

RUGBY.—Alterations to house in Railway Terrace, for C. M. Patchett; builder's workshop at rear of 147, Claremont Road, for F. J. Towers; boiler-house in Bilton Road, for F. Merttens.

RUNCORN.—Houses, Picton Avenue, for Robert Kay.

ST. ALBANS.—Houses, Sandfield Road, for G. E. Willocks; Cambridge Road, for A. Marshall.

ST. ANNE'S-ON-SEA.—Houses, St. Anne's Road East, for R. Crighton; Headroomgate Road, for Muirhead & Co.; Riley Avenue, for J. Sutcliffe; Lord Street, for J. Whiteside; St. David's Road North, for Langford & Slater.

ST. NEOTS (HUNTS.).—Houses, Shaftesbury Avenue, for J. Stocker.

SANDBACH (CHESHIRE).—New secondary school. County Architect, Chester.

SHANKLIN (ISLE OF WIGHT).—Pavilion at the pier, for the Pier Co. (£3,000). Mr. Thorne, contractor.

SHAW.—New premises for the Newtown Street P.S.A. Society.

SHEFFIELD.—Cookery centre, &c., at Townhead Street Schools, for the Education Committee; H. L. Paterson, architect, 19, St. James's Street, Sheffield. Proposed new central library for the T.C.; City Architect.

SHREWSBURY.—Elementary schools at Coleham for the T.C. A. B. & W. Scott Deakin, architects, 12A, Pride Hill, Shrewsbury.

SOUTHPORT (BIRKDALE).—Public baths under consideration. Birkdale Council.

STEVENAGE.—Elementary schools for Herts. C.C. (£3,650.)

STOCKPORT.—Proposed new works, Canada Street and Regent Road, Heaviley, for J. Horn (Stockport), Ltd., confectionery, jam, &c., manufacturers.

STOKE.—Two houses in Trent Vale. Mr. Hancock, Trent Vale, Stoke-on-Trent.

Two houses in Kensington Road. W. Wakefield.

SUDBURY (DERBYSHIRE).—Improved sewage scheme contemplated. Surveyor, Council Offices, Sudbury.

SUNDERLAND.—Houses, Roker Park Road South, for R. Swan, builder; J. Potts & Son, architects, 57, John Street, Sunderland. Houses, Roxburgh Street, Monkwearmouth, for R. Muirhead; J. Potts and Son, architects. Houses, St. Leonard Street, for M. Howarth; Canon Cochin Street, for J. M. Gibbons. Houses, Beechwood Street, for J. Carter; G. T. Brown, architect, 51, Fawcett Street, Sunderland. Organ factory, Back Hylton Road, for H. S. Vincent & Co.; Henderson & Hall, architects, 28, John Street, Sunderland.

TABLEY (CHESHIRE).—Extension of Lady Leighton's Schools (£646). T. Williams & Son, builders, Altrincham.

TONBRIDGE.—Houses, Springwell Road, for Max Warren; The Drive, for A. Heades; Pembury Road, for Miss H. J. Botten; Goldsmid Road, for C. J. Fowler; Mabledon Road, for W. Groombridge, builder, 6, Waterloo Road; Barden Road, for K. C. Jarvis, builder, 21, Baltic Road; alterations to Bayham House, High Street, for Dr. Newton; alterations to Manor House, for C. H. Crofts; additions to Emleigh, Hadlow Road, for H. A. Beeching; alterations to 10 and 12, Woodside, for J. Jeffery; alterations to 212, High Street, for F. L. Pattisson; additions to Castle Hotel and office for the Dartford Brewery Co., Ltd.; studio, 191, High Street, for B. C. Flemons.

TREDEGAR.—Villa, Duke's Town Road, for E. Thomas, Sirhowy Yard; nineteen houses, Mile Field, for the Tredegar Workmen's Building Society.

TUNBRIDGE WELLS.—Houses, Woodland Road, for G. Hudson; Culverden Avenue, for Mr. Ellis; Sandhurst Road, for Soper & Jones, builders, 73, Calverley Road; Somerset Road, for A. T. Child; Erskine Park Road, for W. Farmer; Culverden Avenue, for E. Smith; conversion of one house into two, and additions to Cadogan House, for C. M. & J. E. Strange, builders; additions to Culverden Down Schools, for the trustees of Down Lane School; additions to 111, Upper Grosvenor Road, for A. F. Fairhall.

UTTOXETER.—Laundry to be rebuilt in Heath Road, for the Imperial Laundry Co..

WANTAGE.—House, Belmont, for A. J. East; additions to flour mills, Mill Street, for Messrs. Clarke, Ltd,

WARLINGHAM (near CROYDON).—Houses, Farleigh Road, for J. W. Morris; West Hill Road, for E. Marwood, builder, Whyteleafe; Warren Park, for E. Sabey.

WARMINSTER (WILTS.).—House in Portway, for Mr. Day; Long & Glass, architects, 53, Market Place, Warminster.

WATERLOO (near LIVERPOOL).—Thirteen houses, Milton Road, for Jas. Houghton; alterations and additions to 13 and 16, Adelaide Terrace, for Messrs. Padley.

WEST HARTLEPOOL.—Saw mill, Seaton Road, for J. W. Baird & Co.

WIMBORNE.—Prospective rebuilding, after fire, of St. Giles's Church.

WINDSOR.—Houses at Sunningdale, for Miss Girdlestone.

WOLDINGHAM (near GODSTONE).—House, Station Road, for A. M. Cawthorne; new schools for Surrey Education Committee.

YARMOUTH.—Proposed additions to the Workhouse for the B.G. (£6,108); new offices, South Quay, for the Port and Haven Commissioners; house, Sussex Road, Gorleston, for J. C. Knight; house, Ferry Hill, Southtown, for W. George; two lock-up shops, Pier Walk, Gorleston, for E. J. Middleton.

New Primary Cell.—It is reported that a new primary battery has been invented by Mr. W. A. F. Bleek, a resident of Brisbane, Queensland. The battery is very simple, compact and easily charged.

FORTHCOMING EVENTS.

To-day's Events (Friday, October 16th).—Visit of the Municipal Electrical Association to the Exhibition at Manchester.

At 8 p.m. At the Institution House. Institution of Mechanical Engineers. Paper on "Repairs, Renewals, Deterioration and Depreciation of Workshop Plant and Machinery," by Mr. J. E. Darbishire.

Saturday, October 17th.—Meeting of Electrical Contractors at the Manchester Electrical Exhibition.

Monday, October 19th.—At 7 p.m. At Royal United Service Institution, Whitehall. Junior Institution of Engineers. Annual general meeting, followed by annual general meeting of the Benevolent Fund. At 8 p.m., "Some Notes on Hydraulic Plate-Cutting and Riveting Machines," by Mr. Norman S. Trustrum.

Friday, October 23rd.—At 3.30 p.m. At the National Physical Laboratory, Teddington. Physical Society. Series of demonstration of work in progress in the Laboratory.

At 7.30. Physical Laboratory of the University of Manchester. Institution of Electrical Engineers (Manchester Local Section). Chairman's address, by Mr. Miles Walker, M.I.E.E.

King's Hall, Holborn Restaurant. Electro-Harmonic Society. First concert of the season. (See "Notes" columns to-day.)

Saturday, October 24th.—Liverpool and District Electrical Association. Visit to the Manchester Electrical Exhibition; 2.40 train from Exchange Station.

NOTES.

Our Committee Portraits.—We regret that the photographic print of Mr. J. McDermott, who represents the contracting interests on the Exhibition Committee, was so faint that our touchers-up in their zeal to penetrate the mist and bring out the good points of the subject found it necessary, or shall we say thought it desirable, to make amends for the photographer's neglect, with the result that Mr. McDermott, when we had the pleasure of meeting him at the Exhibition, was found to be not favourably represented by the photograph. This is entirely the combined fault of the poor original photographic print and the enthusiasm of the artist, and we can assure our readers that Mr. McDermott is in no way responsible for the effect produced on page 541 of the ELECTRICAL REVIEW of October 2nd, 1908.

Tramcar Driver's Reward.—The Nelson T.C. on October 8th decided to award driver H. Dean a badge and allowance for meritorious conduct on the 6th inst. whilst driving a light railway car, which resulted in the saving of a child's life.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER LOCAL SECTION).—The following is a provisional syllabus of arrangements for the coming Session. The meetings are to be held at the Physical Laboratory of the University of Manchester on Tuesdays, at 7.30 p.m. Provisional syllabus:—

October 23rd.—M. Walker, M.I.E.E., Chairman's Address.
November 3rd.—M. Kloss, Dr.-Ing., "Practical Considerations in the Selection of Turbo-Alternators."
November 17th.—R. G. Cunliffe, M.Sc.Tech., and J. G. Cunliffe, M.Sc.Tech., "Vagabond Currents."
December 1st.—W. Cramp, M.I.E.E., "The Electrical Discharge and the Manufacture of Nitrogen Compounds."
December 15th.—A. P. M. Fleming, A.M.I.E.E., and K. M. Faye-Hansen, A.M.I.E.E., "Transformers—Some Theoretical and Practical Considerations."
January 12th, 1909.—M. Walker, M.I.E.E., "The Improvement of Power Factor in Alternating-Current Systems."
January 26th.—Dr. E. Rosenberg, M.I.E.E., "Parallel Operation of Alternators."
February 9th.—Dr. W. G. Rhodes, M.I.E.E., "An Elementary Treatment of some Alternating-Current Problems."
February 23rd.—J. S. Peck, M.I.E.E., "Load Equalisers."
February 26th.—Annual Dinner.
March 9th.—C. E. Douglas, A.M.I.E.E., "Large Gas Engines for Electrical Driving."
March 23rd.—Annual General Meeting, and Lecture by Prof. E. Rutherford.

The arrangements for the Students' Section at Manchester are as follows, the meetings being held at the Municipal School of Technology, Whitworth Street, Manchester, on Tuesday evenings, at 7.30 p.m.:—

October 27th.—Supper and smoking concert.
November 10th.—R. F. Blackmore, "Brush-gear."
November 24th.—J. H. Baxter, "Central Station Design."
December 8th.—P. C. Jones, "Single-phase Railways."
January 5th, 1909.—L. H. A. Carr, B.Sc., Tech., "Notes on the Elimination of Sparking."
January 19th.—J. Wilson, B.Sc., "H.T. Aerial Transmission Lines."
February 2nd.—J. G. Cunliffe, M.Sc., Tech., and R. G. Cunliffe, M.Sc., Tech., "Automatic Devices for Tramway Working."
February 16th.—C. S. Richards, B.Sc., Tech., "The Utilisation of Exhaust Steam for Electric Driving."
March 2nd.—B. E. Stott and J. Hargrove, "The Design of Small D.C. Machines."
March 16th.—Annual General Meeting. F. Moore, "Electrolytic Zinc Manufacture."

Visits have been arranged on Saturday afternoons as follows:—
November 14th.—The Stuart Street Generating Station of the Manchester Corporation.
November 28th.—The works of Messrs. Hans Renold, Ltd.
December 12th.—The Heysham and Morecambe Electric Railway.
January 9th, 1909.—The Hyde Road Car Works and Sheds of the Manchester Corporation Tramways.
January 23rd.—The Polygon Testing Station of the Manchester Corporation Electricity Department.
February 6th.—Announcement later.
February 20th.—The Works of Messrs. Crossley Bros., Ltd., Openshaw.
March 6th.—The electrical installation of the Collins Green Colliery Co., Ltd., Earlestown.

Rugby Engineering Society.—At last night's meeting, Mr. A. F. Bennett was to deliver his presidential address on "Notes on the Progress of Steam Engineering."

The Institution of Municipal Engineers.—The membership roll now stands at 345, and offices have been taken at 39, Victoria Street, Westminster, S.W. The draft of the proposed by-laws of the Institution has been considered and approved. The designatory agnomen for members is to be "M.I.Mun.E."

Electrical Standardising, Testing and Training Institution.—The following arrangements for special lectures to be delivered during the Michaelmas term have been made by the Governors of Faraday House:—

Generator Design.—H. M. Hobart, M.I.C.E., M.I.E.E.
Electrical Measurements.—Mr. John Rennie, M.I.E.E., of the Board of Trade Electrical Standards Laboratory.
Fuel Economy.—Mr. J. B. C. Kershaw, F.I.C.

Mersey Railway Co. v. British Westinghouse Co., Ltd.—In the Divisional Court on Tuesday, before the Lord Chief Justice, Mr. Justice Bingham, and Mr. Justice Walton, the case was heard of the Mersey Railway Co. *v.* the British Westinghouse Electric and Manufacturing Co., Ltd., which came before the Court on a case stated for their Lordships' opinion. Mr. C. A. Cripps, K.C., and Mr. Disturral appeared for the British Westinghouse Electric and Manufacturing Co., and Mr. Astbury, K.C., for the Mersey Railway Co. Mr. Cripps said that so far as they were concerned they were satisfied with the case. The British Westinghouse Electric and Mfg. Co. had undertaken the electrification of the Mersey Railway, and as the railway company were not in a position to pay cash to any considerable extent, and provision was made for payment, with the exception of a sum of £15,303 in debentures to be issued from time and time, and it was in reference to this arrangement that the arbitration proceedings took place. The first point raised was as to whether it was right to have a renewal fund to renew electrical plant as it wore out. The Arbitrator held that this was a proper business arrangement, and that it was necessary that there should be a renewal fund. The other point was that a sum of £5,000 which had been voted to the chairman of the Mersey Railway Co. for services, and the British Westinghouse Electric and Manufacturing Co. thought that there was no obligation in connection with that sum. His clients intended to press the contention on that point. Another point was that the British Westinghouse Electric and Manufacturing Co. provided certain goods for the Mersey Railway Co. outside the work, and they claimed to set all the amount due from the Mersey Railway Co. to them against the claim of the latter. The Arbitrator held that the defendants were entitled to do this.

Mr. Astbury, K.C., stated that when the electrification was undertaken, the Mersey Railway Co. had a debenture debt, and they were in danger of a receiver being put in. They accordingly approached the contractors, and laid the matter before them. The Mersey Railway Co. could not possibly pay the interest on their debt, and an arrangement was come to that the British Westinghouse Electric and Manufacturing Co. should during the interruption in the running of the line, caused by the electrification, guarantee that there should be no possible chance of the debenture-holders stepping in and appointing a receiver.

The hearing was adjourned.

A Compulsory Stop.—At the Manchester City Police Court on Wednesday, Monté Callow was summoned for doing damage to the property of the Corporation Tramways Department. John Fishwick said that on October 1st he was the guard of a car from Fallowfield to town. At a stopping-place in High Street the car slowed up, but as no one appeared it went on. Then the defendant came down the stairs and desired to get off; he was told he should have come down at the stopping-place, and replied, "Stop the car at once." He pressed the bell, keeping his hand there, and snatched the trolley rope from the trolley boy's hand and let it go, with the result that an overhead wire was broken.

Mr. Murray, for the defendant, said Mr. Callow was an electrical engineer at the Electrical Exhibition. He admitted having done something he ought not to have done, but said he was greatly annoyed.

A fine of 20s. and costs was inflicted.

Sequel to Fife Pit Disaster.—An action has been raised in Kirkcaldy Sheriff Court by John McGinn, miner, Lochore, against the Fife Coal Co. Pursuer sues for £500 damages in respect of injuries which he sustained while at work in the Mary Pit, Lochore. Pursuer says that the fireman, who ought to have inspected the workings before the miners went to work, was not available at the moment, and the pursuer was sent by the overs-man at the pit to switch on the current of an electric fan for ventilation. Immediately after he started the motor a terrific explosion of inflammable gas took place in the seam. The explosion was followed by three other explosions in rapid succession. Three of the pursuer's fellow-workmen were precipitated down the shaft by the force of the explosion, and were either instantly killed or fatally injured. Pursuer was injured and totally incapacitated for work. He alleges that the accident was attributable to the fault of the defenders or their servants. Defenders plead that the action is irrelevant, and that the pursuer's injuries were not attributable to any default in their system of working the mine.

Educational Notes.—The British Correspondence School of Electrical Engineering.—The new syllabus of this young but enterprising Institution has recently been issued, and gives an account of the aims and claims of the organisers, whose object is to give "bread and butter" instruction; that is, instruction which bears directly upon the practical problems met with in everyday work, and thus improves the earning capacity of the student. No text-books are supplied with the courses, the directors believing that modern developments cannot be taught by their agency; up-to-date information is their speciality. Judging by the opinions of students quoted in the syllabus, their belief is justified by the results.

The courses are divided into Elementary Electrical Engineering, Practical Problems and their Solutions, Practical Electrical Engineering, Management of Installations, Electric Wiring, and Electric Tramway and Railway Engineering—the second and last of these being new additions. The lessons seem well arranged and thoroughly practical, and the small reproductions in the syllabus of the drawings supplied to the students are clear and self-explanatory. The technical directors are Messrs. Frank Broadbent and Andrew Stewart, both of whom are well known in the electrical world and have wide practical experience.

Storey Technical Institute, Lancaster.—The new technical department of this Institute, which is the gift of Mr. H. W. Storey, is provided with an electrical laboratory capable of accommodating 32 students, a storage battery, and various dynamos, motors, &c. Energy is supplied from the Corporation mains.

Imperial College of Science.—On Wednesday last week, Sir William White distributed the prizes gained by students of the Imperial College of Science and Technology during the past year; the Rector, Dr. H. E. Bovey, in the course of an address, announced that the Bessemer Memorial Committee had provided for the equipment of the new mining and metallurgical laboratories, the erection of which would shortly be commenced, that Mr. Chas. Hawksley had given £4,000 for the equipment and endowment of an hydraulic laboratory in memory of his father, and that the King had heartily approved of the equipment and endowment of the electrical engineering laboratories in memory of Lord Kelvin.

The Academy of Sciences, Berlin, has received a legacy of £1,500,000, the entire fortune of an ex-banker named Samson.

International Conference on Electrical Units and Standards.—The conference was begun on Monday last at the rooms of the Royal Society, Burlington House. Mr. Churchill, President of the Board of Trade, opened the proceedings with an address, in which he pointed out that 14 years had elapsed since the last International Congress was held, and welcomed the delegates. Rules of procedure, based upon those employed at the Berlin Conference on Radio-Telegraphy, were adopted, after which Mr. Churchill, on behalf of the British Government, nominated Lord Rayleigh as chairman, and retired.

The first subject discussed was the value of the ohm; the c.g.s. system of measurement was formally adopted, on the motion of Mr. Trotter, and it was agreed that the international ohm should be defined in terms of a column of mercury. Prof. Warburg, of the Reichsanstalt, proposed a resolution fixing the mass of the column at 14·4521 gm. and its length at 106·300 cm., and adopting the procedure for the determination of its resistance set out in "Specification A." The resolution was discussed and referred to the technical committee.

In the evening the delegates were entertained at dinner by the Royal Society Club, and attended a reception held by Lord Rayleigh and the Council of the Royal Society.

On Wednesday, the question whether the volt or the ampere should be adopted as the second primary standard was discussed, and the ampere was chosen by a majority of 19 to 4.

The International Electro-technical Commission, which is a separate organisation, though comprising largely the same *personnel*, commences its sittings on Monday next.

Electricity Classes Abandoned.—The Ramsbottom District Council Higher Education Committee has decided to close the classes in Magnetism and Electricity, owing to there being so poor an entry. Many students appear to be going to bigger centres for instruction in electricity.

Electric Shock Fatality.—An inquest was held at Queensborough the other day concerning the death of Henry Percy Rothwell, assistant manager of the Coal Washing Works. From the evidence it appeared that he went on the roof of a new weigh-bridge house to examine it, when his head came into contact with a "live" electric wire (6,500 volts) 5 ft. from the roof. He was thrown to the ground, and expired in 20 minutes from shock. The jury returned a verdict of accidental death, and expressed the opinion that electric wires should be protected where they crossed the buildings.

New Electrical Laboratory at Dundee.—Lady Marjorie Sinclair, wife of the Secretary for Scotland, on Saturday laid the foundation stone of a new electrical engineering laboratory which is being erected in connection with Dundee University College.

Appointments Vacant.—Car-shed foreman for Stockport (£175); head of the Department of Physics and Electrical Engineering at the Victoria Jubilee Technical Institute, Bombay. See an "Official Notice" this week.

Sewage Purified by Electricity.—An apparatus has been installed at Santa Monica, in California, for the purification of sewage by electricity by the "Harris" process. The cost for electrical energy is said to be 50 cents for 1,000,000 gallons of sewage.

Franco-British Exhibition Awards.—In the *Times* of yesterday there appeared a full list of the awards to exhibitors at Shepherd's Bush.

Chrystal v. J. G. White & Co., Ltd.—Sheriff Blair, at Dumbarton, has made avizandum in an interesting action raised by W. J. Chrystal against J. G. White & Co., the contractors for the Dumbarton Burgh and County Tramways, Ltd., Mr. Chrystal seeks to recover £94, as loss and damage sustained through his motor-car having collided with a large metal pole (of the type used for carrying overhead tramway wires) which was lying on the road, pursuer averring that the pole was in such a position as to constitute a danger to vehicular traffic. The defence was that the pole did not project on to the road, and that the accident was the fault of the pursuer's chauffeur.

The Electro-Harmonic Society.—The first Smoking Concert of the twenty-third season of this Society will be held in the King's Hall, Holborn Restaurant, on Friday evening, the 23rd inst.; the chair will be taken by Sir John Gavey, C.B. The programme will include songs by Mr. Gwilym Richards, Mr. Robert Radford, duets for two violins with pianoforte accompaniment by Mr. Spencer Dyke, Mr. T. E. Gatehouse and Mr. A. E. Izard, and humorous and musical sketches by Mr. Frederick Chester, Mr. Fred Stephens, Mr. Kenneth Hardy and Mr. Harrison Hill. Invitations to the concert are being sent to the members of the International Conference on Electrical Units and Standards, and of the International Electro-Technical Commission, now assembled in London.

Electrical Football League. — Fixtures for this week are as follows:—At Swains Lane, Highgate, St. Pancras Electric *v.* General Electric F.C. At Wormholt Farm, No. 8 pitch, Shepherd's Bush, Ediswan *v.* County of London Electric Southern Section. The kick-off in each case is at 3.30 p.m. Last week the Metropolitan Electric defeated County of London Electric by 2 goals to nil at Southfields.

Manchester Exhibition.—On Saturday a party of upwards of 50 foremen of Messrs. Siemens Bros. Dynamo Works, Ltd., Stafford, accompanied by some of the officials, made an excursion to Manchester to visit the Electrical Exhibition. The party was met on arrival at London Road Station by several of the members of Messrs. Siemens's Manchester branch, who had made excellent arrangements for its entertainment. A special car took the party to and from the Exhibition, and the members, having three and a-half hours there, were able to appreciate it fully. Afterwards an enjoyable spread was partaken of at the Star Hotel, followed by a "Smoker" for the rest of the evening. The members of Siemens's Stafford Engineering Society will visit the Exhibition on October 17th.

On Saturday, October 17th, the members of the Rugby Engineering Society will pay a visit to the Exhibition.

Stadium Sports.—In our last issue we referred to the fact that the West Ham Electricity Works were entering a tug-of-war team at the Stadium Sports. Another team entered was from the Central London Railway, being mainly drawn from the power house staff, who pulled in each round from start to finish, and came out in front without having been pulled once, thus winning the championship of London for teams under 100 stone, their weight being 97½ stone. The team consisted of five men and coach from power house staff, one motor train driver, and two men from the traffic department. Mr. Chas. Forgan, power house superintendent, acted as trainer.

The London Power Bills.—The London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Companies' Bill were down for second reading on Monday, but, as they were opposed on the orders being read, they were not proceeded with. The *Times* says that the debate is not expected now to be taken until Monday next.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Southport Corporation Electricity Committee has decided to increase the salary of MR. A. S. BLACK, the electrical engineer, by £50 per annum from November 1st, making £400 per annum.

At the last meeting of the Johannesburg Town Council it was decided to invite applications in South Africa for the post of town electrical engineer, at a salary of £1,000 a year. Since the resignation of the general manager of the electricity department, it has been decided to re-arrange the control of the same, and to appoint a town electrical engineer, tramway manager, and distribution engineer. In accordance with this arrangement it was decided to appoint MR. TYRREL as tramway manager at a commencing salary of £800 per year, dating from November 1st next, and the post of distribution engineer has for some time been filled by Mr. Gibb.

MR. F. H. BRANDRETH, of Preston Supply Co., has been appointed chief assistant engineer to the Urban Electric Supply Co., Ltd., Grantham. Mr. J. E. Edmundson will continue to superintend the Grantham, Stamford, and Melton Mowbray undertakings. Mr. S. R. Seymour, who has been transferred from Grantham to Twickenham, was presented on the 12th inst. by the Grantham staff with a Waterman fountain pen as a mark of esteem.

MR. H. BELL, one of the engineers-in-charge of Hammersmith Borough Council, has resigned. Two hundred and seventy-five applications were received by the Council for the appointment of two junior engineers. The commencing salary is £135, rising £5 annually to £150, and the positions have been secured by MR. W. A. KITCHEN, Hatch End, and MR. C. H. THORPE, Hither Green. MR. W. G. TILLOTT, mains superintendent at Hammersmith, has resigned his position on account of ill-health, and is going to New Zealand. Mr. Tillott was in the service of Hammersmith Electricity Department for 11 years. MR. H. S. TAYLOR, mains assistant, has been appointed to the vacancy at a salary of £140, rising by £5 per annum, to a maximum of £150 per annum.

MR. C. A. H. HUGHES, assistant in the Corporation Electric Lighting Department at Derby, has resigned, and MR. W. R. POOL has been promoted to his position.

MR. FARRER, manager for the Ramsgate and District Electric Supply Co., has been appointed to a similar position at Twickenham, and will be succeeded at Ramsgate by MR. C. E. HUME, of Twickenham.

The staff at the Gillingham (Kent) E.L. works have presented a travelling bag to MR. A. C. O. FORSTER, who is leaving to take up a position with the Charing Cross and City Electricity Supply Co., Ltd.

The Gillingham T.C. has appointed MR. D. RITSON, a pupil at the electricity works to be shift engineer.

Tonbridge U.D.C. has appointed MR. WOOD, assistant engineer, to attend to the testing and calibrating of meters, and has increased his salary.

MR. GILBERT, late of the Tonbridge U.D.C. electricity staff, has commenced business in the town as a wiring contractor.

MR. D. E. GILES has resigned his position at the Summer Lane station of the Birmingham Corporation, in order to take over the management of the electrical machinery department of Messrs. W. A. Ryan & Co.'s works in Auckland, New Zealand. Mr. Giles will be glad to receive price lists and catalogues from any firms wishing to open up agencies or to do work in New Zealand. He is leaving the Birmingham Corporation at the end of this month.

On Saturday last Mr. J. Plowright, chief assistant engineer of the Windsor Electric Supply Co., on behalf of the staff, presented a silver cigarette-case and matchbox, suitably engraved, to MR. L. H. HOWE, on his leaving to take up an appointment under the Aldershot Town Electric Co.

General.—MR. MONCRIEFF P. FORD has resigned his position as managing director of the Brooke Tool Manufacturing Co., and he is now with Mr. S. N. Brayshaw, of Manchester, whose exhibit at Manchester Exhibition is referred to on another page of this issue. Mr. Ford is present at the stand.

MR. E. MACGREGOR DUNCAN, of 27, Old Queen Street, Westminster, has joined the board of the Windsor Electrical Installation Co., Ltd., which is the company supplying electricity in Windsor, Eton, and Old Windsor.

We are asked to state that MR. CYRIL GREIG, of the A.E.G. English Manufacturing Co., Ltd., who has been associated with the Nernst lamp, especially with regard to street lighting, has now left the company's employ.

MR. W. J. FURSE, electrical engineer, Nottingham, was on Saturday presented by his employés with a silver rose bowl on the occasion of his silver wedding.

MESSRS. ROBERTSON & ADAMS, consulting engineers and electricians, have removed from No. 60 to No. 52, St. Enoch's Square, Glasgow, where all communications, catalogues, &c., should be addressed.

MR. THEODORE RICH has severed his connection with Messrs. Willans & Robinson. His address for the present will be 104, St. George's Square, S.W.

Obituary.—On September 9th, after a short illness, PROF. ALEXANDER VOLTA, a nephew of the illustrious Volta, the inventor of the voltaic battery, died at Camnago.

The Council of the Junior Institution of Engineers has with deep regret sent us an announcement of the decease of the President of the Institution, M. GUSTAVE CANET, the eminent French Artillerist, which took place at La Tourelle, St. Aubin-sur-Mer, France, on October 8th.

CITY NOTES.

Victoria Falls Power Co., Ltd.

THE report for the period from the incorporation of the company (October 17th, 1906), to December 31st, 1907, states (according to the *Financial Times*) that a profit and loss account has not been included because the year 1907, and also the current year, are, and will be, occupied by the work of construction, during which interest on the preference shares issued in December, 1906, is paid by the British South Africa Co. A revenue and expenditure account is included in the balance-sheet, and £36,685, being the surplus revenue over expenditure, is carried forward to the current year. The issued share capital of the company is £1,808,000, divided into 1,000,000 ordinary shares of £1 each, which have been issued fully paid in the terms of the prospectus, dated December 15th, 1906, and 808,000 fully-paid preference shares of £1 each. £800,000 debentures have also been issued. The undertaking in South Africa of the Rand Central Electric Works, Ltd., was purchased by this company as a going concern as from January 31st, 1907. It is intended, when the new stations now being erected by the company have been completed, to utilise this plant as a reserve. The anticipation in the prospectus that the earnings from the exist-

ing station of the General Electric Power Co., Ltd., would cover the general expenses during the period of construction has been fully realised. These earnings, with those of the Rand Central works, have enabled the company, even during the construction period, to accumulate a substantial fund which is available for the general purposes of the company. The company has entered into a number of important contracts for the supply of power to mines. The Germiston and Boksburg municipalities take the whole of their requirements from this company. The contracts taken over from the African Concessions Syndicate, Ltd., in relation to the supply of power, provided for the payment of certain commissions to the agent employed to negotiate them. As the terms were not free from ambiguity, one of the first acts of the board was to negotiate a new contract which is more favourable to this company. Under the new contract, commissions of varying amount are payable for a limited term on the receipts from power supplied to certain groups. Major the Hon. Walter L. Bagot, D.S.O., has been appointed general manager of the company in South Africa. Mr. Arthur E. Hadley, who has throughout been the alternate director for Herr Geheimrath Rathenau, has been elected a director.

Ferranti, Ltd.

The directors' report for the year to June 30th, 1908, states that the profit on trading for the year was £31,166, and, after crediting discounts and interests and transfer fees, and deducting general establishment charges, repairs and renewals, legal expenses, bad debts, and directors' and trustees' fees, there remains a balance of £15,421, which has been applied as follows:—Expenses *re* prior lien debentures, £339 11s.; interest on prior lien debentures, £568; interest on first mortgage debenture stock, £5,000; interest on bank loan, £1,239; amount charged in respect of depreciation, £5,000; leaving a balance of £3,275. This sum has been deducted from the balance standing at the debit of profit and loss account at June 30th, 1907, reducing the net debit balance to £2,137. The keen competition in the industry, which has existed for some time past, does not show any signs of abatement, but, notwithstanding this, the results for the year are better than those of the previous year. The prior lien debentures for £20,000 were issued during the year, and the additional working capital thereby afforded to the company has been of considerable benefit. All expenses in connection with the issue have been charged to profit and loss account. The directors who retire by rotation are Mr. A. W. Tait and Mr. J. M. Henderson, who, being eligible, offer themselves for re-election. The directors, in exercise of the powers contained in the articles of association, appointed Mr. A. B. Anderson managing director of the company. The appointment of Mr. Anderson as a director is submitted for confirmation.

Drake & Gorham, Ltd.

The directors' report for the year ended June 30th, 1908, shows that after payment of all charges, including bonuses due to staff, there remains a net profit of £6,179, which, with the sum of £1,399 brought forward from the previous year, makes a total of £7,578, which it is proposed to appropriate—by payment of a dividend at the rate of 5 per cent. per annum, £6,250, and by carrying forward £1,328. The directors are pleased to report that the results of the year's working enable them to recommend a dividend at the rate of 5 per cent.; this is all the more gratifying in view of the fact that there has been little improvement in the financial conditions which affect the company's trade. There has been a considerable increase in the trade department which deals with agencies, and the financial results shown are satisfactory. The mills, to which reference was made in the last report, have been satisfactorily completed. Mr. Gorham has ceased to act as a managing director, but retains his seat on the board. Mr. M. G. Drake and Mr. Hamilton have been appointed managing directors in lieu of employé-managing directors.

Anglo-Malay Rubber Co., Ltd.—The directors announce an interim dividend at the rate of 20 per cent. per annum for the half-year ended June 30th last, free of income-tax.

Mexican Light and Power Co.—A dividend of 3½ per cent. has been declared on the preference shares.

Western Union Telegraph Co.—The annual meeting takes place on 14th inst., and a dividend of ½ per cent. has been declared on the stock. The surplus, after allowing for dividend and estimating the position of the company at September 30th, 1908, amounts to $15,163,004.

Stothert & Pitt.—The *Times* states that the directors after transferring £3,001 to the reserve fund, recommend a dividend of 2s. per share, being at the rate of 10 per cent. per annum on the ordinary shares for the year ended June 30th. A balance of £1,022 remains to be carried forward.

Clyde Valley Electrical Power Co.—At the half-yearly meeting of this company held in Glasgow—Mr. A. Bonar Law, M.P., ex-President of the Board of Trade, presiding—the directors reports and statement for the last year for the company and for the undertaking under the Clydebank Electric Lighting Order, were submitted and unanimously approved. It was stated that the company's output is steadily increasing and contracts with consumers amounted at June 30th to 20,030 H.P., an increase of 4,363 H.P. for the half year.

Companies Struck Off the Register.—According to notice in the *London Gazette* the following companies have been struck off the Register:—

Anti-Friction Roller-Bearing Syndicate, Ltd.
Electrical Appliances Syndicate, Ltd.
Electrical Productions, Ltd.
Electro-Smelting Co., Ltd.
Fuel Oil Co., Ltd.
Helios Electrical Construction Co., Ltd.
Irish Electric Railways Co., Ltd.
Lightning Express Submarine Navigation Syndicate, Ltd.
London Gas Engine Users' Syndicate, Ltd.
Miller Signal Syndicate for India, Ltd.
North-West London Electric Supply Co., Ltd.
Peacock's Patent Steel-Grip Lock-Nut and Fish-Bolt Syndicate, Ltd.
Uddingston District Electric Lighting Co., Ltd.
Western Smoke Consumer and Fuel Economiser, Ltd.

Melbourne Tramway and Omnibus Co., Ltd.—The report for the year ended June 30th, stated that the balance shown, after paying £72,000 in dividends for the year, making the necessary reserves, and including £25,991 brought forward from last year, was £51,507. The directors proposed a dividend bonus of 6d. per share and to give a bonus of 10 per cent. on their salaries to the staff, leaving, to carry forward, £25,079. The traffic receipts are very satisfactory, says the *Financial Times*, representing the carrying of five millions more passengers than in the previous year, and showing an increase of £38,889. During the year the men's hours of work were under consideration, and the directors saw their way to reduce them from 60 to 54 per week from January 1st without lessening their pay. This and the additional traffic have considerably increased the item of wages.

Sociedad Co-operativa Telefonica.—The *Review of the River Plate* publishes the report of the directors for the year ending June 30th last, in which they state that the profits amount to $202,057, as compared with $151,046 for the previous year. The expenses were $539,928, as against $451,270, and revenue $748,547, against $612,990. The year ended with 5,790 subscribers, as compared with 5,349, an increase of 441. The expenses per subscriber were $7.77, against $7.03, and the revenue $10.77, against $9.55. The directors recommend that the dividend, equivalent to 8 per cent. per share, be paid in ordinary shares of the company, the money to be employed in the construction of new lines to La Plata and underground mains in Buenos Ayres. The report was unanimously approved at the meeting, held on September 11th, when 82 shareholders, representing 2,500 shares, were present.

Rede Telephonica Bragantina.—The *Brazilian Review* of September 22nd stated that this company, which had a paid-up capital of $200,000, is issuing a further $100,000 in debentures. "The object of the concern is to provide a telephone service between the following towns in the State of Sao Paulo:—Braganca, Sao Paulo, Santos, Campinas, Amparo, Jundiahy, Itatiba, Soccorro, Atibais, Serra Negra, Piracaia, Sao Joao do Curralinho and Juquery, and the general provision of telephonic communication throughout the State. The said $100,000 will be divided into 1,000 debentures of $100 each, bearing 8 per cent. per annum, payable for the period of 20 years in the cities of Sao Paulo and Braganca. Amortisation will be at the rate of 2·2 per cent. cumulative sinking fund. The type of the present issue is 85 per cent., and the security consists of the property of the company, including 1,200 kilometres of telephone communication and other installations already operating."

Stock Exchange Notice.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Mexico Tramways Co.—$400,000 additional general consolidated first mortgage 50-year 5 per cent. gold bonds, Nos. 12,501 to 12,560 and 13,601 to 14,000 of $500 each, and 32,001 to 32,200, 32,251 to 33,000, 33,591 to 33,750, and 34,751 to 35,250 of $100 each.

Callender's Cable and Construction Co., Ltd.—The directors have declared an interim dividend of 5s. per share, being at the rate of 10 per cent. per annum, payable on November 2nd next. The ordinary share register will be closed from 22nd to 31st inst., both days inclusive, for the purpose of the preparation of warrants.

Indo-European Telegraph Co., Ltd.—The directors have declared an interim dividend for the half-year ending June 30th last at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 2nd. The transfer books will be closed from 18th to 31st inst.

Metallic Seamless Tube Co., Ltd.—According to a financial daily, the net profits for the year ended June 30th, were £3,041, and £3,683 was brought forward. A dividend of 7½ per cent. is recommended on the ordinary shares, carrying forward £4,540.

Direct United States Cable Co., Ltd.—The board have resolved upon the payment of an interim dividend of 4s. per share, free of income-tax, being at the rate of 4 per cent. per annum for the quarter ending September 30th, 1908, such dividend to be payable on and after the 26th inst.

Oriental Telephone and Electric Co., Ltd.—The directors have declared the following interim dividends:—3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income-tax, and 3 per cent. on the ordinary shares, free of income-tax, payable to those shareholders whose names are on the share registers of the company at this date. The warrants will be posted on the 31st inst. The share transfer books are closed from 15th to 28th inst.

MARKET QUOTATIONS.

Wednesday, October 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	22/-	10/- dec.
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	45/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£21	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar..	per ton	£23 10	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	5½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£30	..
a ,, Chlorate	per lb.	5½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	100/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Chlorate	per lb.	5½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a ,, Cyanide (basis 100 %) ..	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£80	..
b ,, Wire, in ton lots ..	per ton	£130	..
b ,, Sheet, in ton lots ..	per ton	£128	..
a Babbitt's metal ingots	per ton	£50 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	¼d. dec.
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	7½d.	..
c ,, Wire, basis	per lb.	6½d.	¼d. dec.
c Copper Tubes (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn) ..	per lb.	9½d.	..
g Copper Bars (best selected) ..	per ton	£78	..
g Copper Sheet	per ton	£78	..
g ,, Rod	per ton	£73	..
c ,, (Electrolytic) Bars ..	per ton	£62 10	£1 dec.
c ,, ,, Sheets ..	per ton	£78 10	£1 dec.
c ,, ,, Rod ..	per ton	£67 10	£1 dec.
c ,, ,, H.C. Wire	per lb.	8d.	¼d. dec.
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	4/6½	3½d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	50/9½	5½d. dec.
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£14	..
g Lead, English Ingot	per ton	£18 10 to £18 12 6	dec.
m Manganin Wire No. 26	per lb.	8/-	..
g Mercury	per bot.	£8 7 6	2/6 inc.
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/1½	..
p ,, rolled bars & rods	per lb.	1/2 to 1/6	..
p ,, ,, strip & sheet	per lb.	1/2½ to 1/5	..
o Platinum	per oz.	85/- to 90/-	..
c Silicium Bronze Wire	per lb.	9d.	¼d. dec.
r Steel, Magnet, in bars	per ton	£15	£5 inc.
Tin, Block (English)	per ton	£131 to £132	10/- dec.
n ,, Wire, Nos. 1 to 18	per lb.	1/9	..
p White Anti-friction Metals— "White Ant" brand	per ton	£34 to £58	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 5	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Rosario Electric Co., Ltd.—The report for the year ended June 30th, 1908, states that the balance at the credit of profit and loss account, after making provision for depreciation of buildings, plant, &c., and for expenses of issuing new capital, is £23,000, plus £4,600 brought forward from last account, making £27,601. The directors propose a dividend of 5s. per share on 12,798 ordinary shares (making a total dividend of 8 per cent. for the year); a dividend at the rate of 8 per cent. on the calls on 64 second preference shares converted into ordinary shares; additional dividend on 442 second preference shares converted into ordinary shares; to allocate £600 as additional remuneration to the directors; to add to the reserve £5,000, carrying forward £6,549. The demand for energy for lighting and power has steadily increased. The cost of working has been affected by the abnormal cost of coal, but since the date of closing the accounts the company is buying upon more favourable terms.

STOCKS AND SHARES.

Tuesday Afternoon.

In consequence of the political events in the Near East, markets are still restless and agitated. After being plunged into gloom and stress, Monday brought relief to prices in all directions and a violent rebound occurred. The very force of the reaction was held by some to contain elements that cried for need of caution in making purchases while the outlook remained unsettled.

In the same rapid way with which Home Railway prices were scaled down in the slump, did they revive upon a more pacific complexion being assumed by the political situation abroad. Direct connection between the business of British Railway companies and the disintegration of the Turkish Empire, might be rather difficult to find, but investment stocks were shaken, of course, by the fears as to what might happen to Consols if a war broke out.

Central London Ordinary and Deferred are both two points lower, and weak holders sold their stock in the slump. Moreover, the near approach of the end of October is held up as a warning that Exhibition traffics only last for a while.

Metropolitan Consols has been down to 37 and up to 41 since we last wrote, and on Tuesday night closed without change at 40. There are rumours that the company may be taken into partnership with one of the bigger companies. District Ordinary is easier, and the recently-issued 4 per cent. prior-lien debenture fell to 1½ discount upon the underwriters being left with about 70 per cent. of their obligations. This not at all surprising result produced no effect upon the prices of the existing debenture stocks, all of which are still very hard.

Electricity Supply shares are not particularly strong. The market heard with indifference of the postponement until next week of Parliament's consideration of the London Electricity Bill. County of London Ordinary shares are down another 5s., while the Preference lost 2s. 6d. Somebody has had a few to sell, and the market has no eager buyers. Charing Cross are also easier; Metropolitan Preference shed ½, but Chelseas gained a similar fraction.

Incidentally, it may be observed that the interim dividend on Stock Exchange shares has just been announced at £4 a share, as against £5 a year ago. Economy is called for by the proprietors, and at the last meeting one shareholder demanded whether it would not be cheaper for the Stock Exchange to get electric current from one of the City supply companies instead of getting it from the private installation of the House. The reply was rather a halting negative.

Speculative issues suffered severely in last week's shake-out amongst the markets. The Canadian group of power and tramway securities was upset, but most of the prices have recovered all they lost. Mexican Electric Light bonds are a point lower. Mexican Light and Power bonds show a loss of 1¾, while the Common and the Preferred stocks are good. Mexico Tramways Common stock fell to 130 before jumping 13 points in a day, to 143; the bonds are steady. Rio shares, at 64½, have lost 2¼; but Sao Paulo gained a point at 154. There is a good deal of business doing in United Electric Tramways of Monte Video 5 per cent. First Debenture stock, the price being about par. Six months' interest is payable at the beginning of next month, and will be deducted from the quotation on October 29th.

Victoria Falls Power Preference strengthened to 15s. in a rush to buy Chartered shares on a cock-and-bull story about the Imperial Government coming to the financial aid of the company. The price subsequently slipped back to 12s. 6d., and the report was officially contradicted.

The continued shrinkage in the price of London United Tramways shares is causing uneasiness, and there must be but few people holding either shares or Debenture stock who could sell without heavy loss. Several years before some of us were taken to task by the late redoubtable Mr. Charles Yerkes for ignorance of the subject had the affairs of this company formed matter for serious criticism in these columns, and from the day that the £10 Preference shares—now standing at 4¾—were offered at a premium, has everything possible been done here to advise proprietors to realise their interests in the concern. British Electric Traction Ordinary recovered after having gone a little lower, but the 5 per cent. First Debenture stock is 2 points down at 92½.

Calcutta Trams have had a sharp set-back. Anglo-Argentine Trams were sold by speculators who had to realise investments in order to meet differences incurred in other markets. Auckland Debenture stock went back a point. British Columbia varieties are somewhat irregular.

Telegraph issues continue so quiet as to call for little comment. Debenture stocks are still in demand. The telephone department is equally quiet. American Telephone and Telegraph stock and bonds each lost a point. In the manufacturing list, a 5s. fall in Callender's Ordinary shares is almost the only alteration.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Oct. 6th.	Closing Quotations Oct. 13th.	Business done week ended Oct. 13th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2 — 3	2 — 3	..	..	..	Nil. 0
136,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½%	7½%	8 %	8 %	130 —134 xd	129 —133 xd	130½	129½	..	6 0 4
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	92 — 94	..	..	—1	4 5 1
598,180	Anglo-American Telegraph	Stock	28%	31%	32%	33%	58 — 61	58 — 61	..	..	..	5 14 9
3,200,910	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	103½—104½	103½—104½	104½	103½	..	5 14 10
3,200,910	Do. do. do. Deferred	Stock	Nil	⅛%	12%	1 %	17 — 17½	16½— 17	17⅜	16½	— ½	5 17 8
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8½	8 — 8½	..	..	..	4 14 1
2,883,376	Commercial Cable Sting. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	88 — 90 xd	88 — 90	89½	88	..	4 8 11
16,000	Cuba Telegraph	10	5 %	5 %	5 %	6 %	7⅞— 8½	7⅞— 8⅜	..	..	..	7 1 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16 — 17	16½— 17½	..	..	+ ½	5 15 11
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3½ xd	3 — 3½	..	..	..	6 3 1
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8 — 9 xd	8 — 9	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	8 14 10
60,710£	Direct United States Cable	20	3½%	4½%	4½%	4½%	13½—13⅝	13⅜— 13⅝	13⅝	..	+ ⅛	6 2 6
53,700£	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	136 —139	136 —139	138½	136½	..	5 0 9
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	85 — 87	85 — 87	86½	85½	..	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104	103½	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅝— 13⅛	12⅝— 13⅛	13⅛	12⅝	..	5 5 6
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	102½	..	..	3 17 8
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101½—103½	101½—103½	..	..	..	3 17 4
181,127	Globe Telegraph and Trust	10	5⅜%	5½%	5½%	5⅝%	10⅝— 11⅛	10⅝— 11⅛	11	10⅜	..	5 5 8
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜— 14⅛	13⅜— 14½	13⅝	..	..	4 4 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24 %	24%	20 %	20 %	30 — 32	29 — 31	..	..	—1	6 9 0
24,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	56 — 59	56 — 59	..	..	..	6 7 1
$41,880,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	68 — 72	68 — 72	..	..	..	5 9 7
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 9 7
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	5/16— 7/16	5/16— 7/16	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	5	4 %	5 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	¾— 1	¾— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110	109½	..	5 8 1
2,725,000	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	118 —120	118 —120	119	118	..	5 0 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½— 11½	10½— 11½	10⅝	10 1/16	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10½— 11½	10½— 11½	..	..	..	4 8 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 11/16	5⅛	..	4 6 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98½—100⅛	98⅛—100⅛	98⅜	98⅛	..	3 7 8
1,716,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..	3 16 11
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	7 %	7 %	8 %	1½— 1⅝	1½— 1⅝	..	..	..	5 16 4
50,000	Do. do. do. 6 % Cum. Pref.. ..	1	6 %	6 %	6 %	6 %	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	4 11 5
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	..	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 7 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	99 —102	100 —103	..	..	+1	3 17 8
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7½— 8½	7½— 8½	..	..	..	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	130 —133	130 —133	..	..	..	4 10 3
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝— 7⅛	6⅝— 6⅞	6 13/16	6⅝	— ⅛	5 16 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5⅜	..	..	..	4 10 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	2½%	2½%	1½— 1⅞	1½— 1⅞	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	100 —103	..	..	+1	3 17 8
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	13⅜— 14½	13⅜— 14⅜	13⅞	13⅜	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101½—103½	102 —104	..	..	+ ½	3 16 11
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ½	⅜— ⅝	..	..	..	Ni
34,568	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8⅜	..	..	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	8½ — 9½	8½ — 9½	..	..	..	2 9 0
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

820,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	9 %	8⅛— 8⅛ xd	8⅛ — 8⅛	8 7/16	8 3/16	— 1/16	5 5 11
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5⅔%	6½ — 6⅞	6½ — 6⅞	6 7/16	..	..	4 11 2
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	143 —148	143 —148	148	..	..	4 6 11
265,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —106	102 —105	..	..	—1	4 15 3
880,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	3⅞— 4 xd	3⅞ — 3⅞	76/10½	73/9	— ⅛	5 8 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅛	..	..	..	5 13 10
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	2⅜— 2⅝	2⅜— 2⅜	..	..	..	12 3 6
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3½— 4	3½— 4	..	..	..	8 15 0
40,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅛— 4⅜	4⅛— 4⅜	..	..	..	6 6 4
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾— 4⅛	3¾— 4⅛	..	..	..	4 14 1
43,473	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	106 —110	106 —110	..	..	..	4 10 11
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	8 %	136 —140	135 —139	..	..	—1	5 15 1
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	117 —121	117 —121	..	..	..	4 2 8
500,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	105 —109	106 —110	108⅝	107½	+1	4 10 11
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —104	103 —105	..	..	+1½	4 5 9
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	104⅜	..	..	4 7 0
188,801	British Electric Traction	10	6 %	3 %	Nil	Nil	⅞— 1⅛	18/1½	16/8	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	3 %	3⅜— 4⅛	3⅜— 4⅛	75/-	72/6	..	7 1 2
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	90 — 96	91 — 96 xd	98	92⅜	..	5 4 2
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	76 — 78	..	..	..	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6⅛— 6⅜	6⅛— 6⅜	..	..	..	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
208,440	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	5/16— 9/16	5/16— 9/16	..	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	40 — 45	40 — 45	..	..	..	8 17 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	11/16— 13/16	11/16— 13/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/8 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	2½%	Nil	Nil	0— ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
125,000£	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	6 3 3
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	8 6 0
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	5½— 6	4⅞— 5½	5⅛	5	+ ⅛	5 14 3
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	..	5 %	5 %	5 %	4⅝— 5¼	4⅞— 6½	98/1½	95/-	— ⅛	4 15 8
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9⅞— 10⅜	9½— 10½	..	..	— ½	7 2 10
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞— 6⅜	5⅞— 6⅛	6 1/16	5⅜	..	5 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107½—109½	107½—109½	..	..	..	4 2 2
491,222	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1 1/16— 1 3/16	1 1/16— 1 3/16	32/6	31/-	..	7 14 10
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	105 —107	103 —107	..	..	..	4 4 1
1,898,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	71 — 73	69 — 71	72⅛	69	—2	4 4 6
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87	..	..	4 10 11
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	51 — 54	49 — 52	51½	50	—2	3 16 11
1,480,000	City and South London Railway	Stock	2½%	1¾%	2½%	2½%	32½— 33½	32½— 33½	33½	32½	..	6 6 10

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Oct. 18th.	Closing Quotations Oct. 18th.	Business done week ended Oct. 6th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	* 8	2½%	2½%	5 %	5 %	1⅝— 1⅝	1⅝— 1⅝	28/1½	..	..	9 10 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	98 —101	98 —101	..	..	..	4 19 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1⅝— 1⅝ xd	1⅝— 1⅝	..	..	..	7 12 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1¼ xd	1 — 1¼	21/6	..	..	4 16 0
276,880	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6¼%	11¼— 12¼	11¼— 12¼	..	..	..	5 4 0
60,000	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12¼— 13¼	12¼— 13¼	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	2½%	4½%	4½%	4½%	⅜— ⅝	⅜— ⅝	14/2	13/6	..	16 12 6
17,189	Do. "A" shares, 01—017,189	5	2½%	4½%	4½%	4½%	1½— 2¼	1½— 2¼	..	..	..	8 6 9
317,875	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 — 87 xd	84 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	2	4 %	Nil	Nil	Nil	⅛— ¼	1/16— 1/8	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1½— 1¾	1½— 1¾	..	..	..	8 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7⅞— 8	7⅞— 8	..	..	..	6 5 0
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	84 — 88 xd	84 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	⅛%	¾— 1	¾— 1	..	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½— 10	10½— 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15%	10½— 11¼	10½— 11½	..	..	..	7 8 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5¼	5 — 5⅛	..	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 — 109	..	..	..	4 2 7
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	5 %	10%	10 %	10 %	16½— 17½	16½— 17½	..	..	..	5 14 8
37,500	†Liverpool Overhead Railway, Ord.	10	13%	Nil	Nil	⅛%	1⅛— 1¼	1⅛— 1¼	..	..	..	4 0 0
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5⅛	..	..	..	9 1 10
600,070	London United Trams. (1901), 1 to 60,007	10	6 %	8 %	8 %	8%	6¾ — 6⅞	6¾ — 6⅞	..	..	..	4 8 11
899,930	Do. do. 60,008 to 100,000	10	6 %	8 %	8 %	8 %	6¾ — 6⅞	6¾ — 6⅞	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	102/6	97/6	— ¼	9 1 10
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	73 — 78	73 — 78	..	..	..	5 2 7
5,782,062	Metropolitan Consolidated	100	3 %	2½%	1 %	½%	39½— 40½	39½— 40½	41½	39½	..	1 4 6
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	68 — 70	68 — 70	69½	68	..	3 18 7
2,235,000	Do. District	100	Nil	Nil	Nil	Nil	13½— 14½	13 — 14	13¼	12⅛	..	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/32— 5/32	3/32— 5/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	15/16— 1	15/16— 1	15/7½	..	..	6 8 1
823,800	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	94½	..	..	4 14 9
245,500	Potteries E. Tre.	1	5 %	4 %	4 %	4 %	¼— ⅜	¼— ⅜	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜— ½	⅜— ½	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	32 — 34	32 — 34	33	32	..	6 18 8
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	5 %	43 — 47	43 — 47	..	..	..	10 12 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	⅜— 1½	⅜— 1½	20/-	..	..	8 0 0
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2½— 3½	2½— 3½	60/-	55/6	..	9 4 7
246,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	72 — 76	..	..	..	5 5 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	6½%	4⅜— 4¾ xd	4⅜— 4⅞	..	..	..	5 11 5
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	96 — 100	96 —100	..	..	..	4 10 0
30,275	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10 %	7 — 8	7 — 8	..	..	..	6 5 0
9,725	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
886,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 — 102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3⅜— 4	3⅜— 3⅞	71/10½	70/-	— ⅛	6 9 0
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅛	3⅞— 4⅛	..	..	— ⅛	5 2 10
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜— 4	3⅜— 4	3⅝	..	..	5 12 6
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 10 11
49,486	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	2⅜— 3⅛	2⅞— 3⅜	65/-	62/6	+ ⅛	6 18 4
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	100½	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½— 10½	9½— 10½	10	..	..	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..	4 12 4
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	*123 —125	124	..	..	4 0 0
300,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	102	101	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	2 %	2½— 3	2½— 3	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3⅝— 4⅛ xd	3⅝— 4⅛	..	..	..	6 1 3
210,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	..	.. — ..	.. — ..	..	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7⅛— 8⅛	7 — 8	..	..	— ⅛	6 5 0
50,026	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜— 10¾	10⅛— 10⅜	..	..	— ⅛	5 11 8
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	Nil	¾— 1	¾— 1	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	59 — 66	..	..	..	6 16 4
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	..	..	83½— 86½	83½— 86½	84½	83½	..	..
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅝— 5⅛ xd	4⅝— 5⅛	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	5 — 5¼ xd	5 — 5¼	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 — 100	97 —100	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	8½%	6 — 6¼	6 — 6¼	..	..	..	6 10 9
$1,325,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	..	94 — 96	94 — 96	..	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	5 14 8
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	⅞— 1⅛	⅞— 1⅛	..	..	..	5 8 1
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜— 4⅝	4⅜— 4⅝	..	..	..	6 9 9
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 92	89 — 92	..	..	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	4⅛— 4⅜	4⅛— 4⅜	..	..	..	6 16 10
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4 — 5	4⅛— 4⅝	93/1½	89/9	..	4 12 4
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	105 —109	..	..	..	4 2 7
248,000‡	Do. 5½ % Mort. Deben. Stock Redem.	Stock	5½%	5½%	5½%	5½%	84 — 89	84 — 89	87½	..	..	5 18 8
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	89 — 90	88 — 89	89½	88	..	5 9 11
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	..	77 — 78	78½— 80½	80½	74½	..	..
$1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	..	112 — 113	111½—112½	112½	111	..	..
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	..	90½— 91½	88½— 90½	91½	89⅜	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	96½	..	..	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	7 19 2
87,500	Do. 5 % Pref., 1 to 87,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 6 11
10,859	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½— 12½	11½— 12½	..	..	..	5 17 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..	5 14 3
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 99	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	..	2½%	..	1⅛— 1⅛	1⅛— 1⅛	23/9	23/6	..	..
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6	6	6	6	1/16— 1/16	1/16— 1/16	..	..	..	..
194,684	Do. do. 5% Deb. Stk. Red.	100	5	5	5	..	99 — 102	99 —102	..	..	..	4 18 0
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7⅜— 8⅛	7⅛— 8⅛	7⅞	7⅞	..	6 1 3
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6⅝— 7⅛	6⅝— 7⅛	..	..	..	4 16 7
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 90	86 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
46,700	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 11 1
65,000	§South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅛— 2⅜	2⅛— 2⅜	..	..	..	7 5 5
120,000	§South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅛— ⅜	⅛— ⅜	..	..	..	4 0 0
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..	6 4 5
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	99	..	..	4 9 1
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾— 1 xd	¾— 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1½— 2⅜ xd	1½— 2⅜	40/7½	..	..	10 10 6
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	..	1/16— 1/16	1/16— 1/16	12/3	..	..	..
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	10 %	8 — 9	8 — 9	8½	..	..	5 11 1
61,979	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	5 — 5½	5 — 5½	5½	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 2½ per cent., May 28th, 1908.

TRADE STATISTICS OF CHILE FOR 1907.

The following figures, showing the imports of electrical and other materials into Chile during the year 1907, have been taken from the recently issued trade statistics; the figures for 1906 are given for purposes of comparison, and notes of increases or decreases have been added:—

	1906. Pesos.	1907. Pesos.	Increase or decrease. Pesos.
Covered Iron Wire.—			
From Great Britain ...	163,746	62,442	— 101,304
„ Germany	96,009	61,293	— 34,716
„ United States ...	66,024	34,113	— 31,911
„ Other countries ...	3,522	9,273	+ 5,751
Total	329,301	167,121	— 162,180
Iron or Steel Wire.—			
From Great Britain ...	154,698	395,669	+ 240,971
„ Germany	774,807	1,331,264	+ 556,457
„ Belgium	168,891	316,973	+ 148,082
„ United States ...	420,835	999,140	+ 578,305
„ Other countries ...	16,842	15,458	— 1,384
Total	1,536,073	3,058,504	+1,522,431
Points, Sleepers, Fishplates, &c., for Railways.—			
From Great Britain ...	135,949	183,198	+ 47,249
„ Germany	95,889	175,326	+ 79,437
„ Belgium	32,475	174,846	+ 142,371
„ United States ...	45,912	19,959	— 25,953
„ Other countries ...	3,330	6,327	+ 2,997
Total	313,555	559,656	+ 246,101
Gas or Electric Light Meters.—			
From Great Britain ...	37,188	42,552	+ 5,364
„ Germany	2,440	45,804	+ 43,364
„ Other countries ...	816	376	— 440
Total	40,444	88,732	+ 48,288
Rails.—			
From Great Britain ...	1,265,518	1,606,704	+ 341,186
„ Germany	405,638	815,448	+ 409,810
„ Belgium	127,942	873,316	+ 745,374
„ United States ...	51,048	192,004	+ 140,956
„ Other countries ...	163,136	71,604	— 91,532
Total	2,013,282	3,559,076	+1,545,794
Bronze, Copper, or Lead Wire.—			
From Great Britain ...	27,285	82,855	+ 55,570
„ Germany	119,147	287,410	+ 168,263
„ United States ...	29,541	73,551	+ 44,010
„ Other countries ...	1,047	4,848	+ 3,801
Total	177,020	448,664	+ 271,644
Insulators of Glass for Telegraphs and Telephones.—			
From Great Britain ...	3,081	22,821	+ 19,740
„ Germany	4,161	56,235	+ 52,074
„ United States ...	1,161	13,959	+ 12,798
„ Other countries ...	24	1,407	+ 1,383
Total	8,427	94,422	+ 85,995
Other Insulators for Telegraphs and Telephones.—			
From Great Britain ...	15,753	6,837	— 8,916
„ Germany	89,772	77,862	— 11,910
„ Belgium	72	18,678	+ 18,606
„ Other countries ...	1,611	8,085	+ 6,474
Total	107,208	111,462	+ 4,254
Telegraph Apparatus.—			
From Great Britain ...	48,960	1,440	— 47,520
„ Germany ...	9,440	2,480	— 6,960
„ United States ...	3,280	2,160	— 1,120
Total	61,680	6,080	— 55,600
Hand Electric Lamps.—			
From Great Britain ...	—	422	+ 422
„ Germany ...	514	2,748	+ 2,234
„ France	32	9,129	+ 9,097
„ Other countries ...	54	—	— 54
Total	600	12,299	+ 11,699
Telephones.—			
From Great Britain ...	3,340	4,900	+ 1,560
„ Germany ...	44,480	146,100	+ 101,620
„ United States ...	21,160	8,040	— 13,120
Other countries ...	920	20	— 900
Total	69,900	159,060	+ 89,160
Apparatus for Telegraphs and Telephones.—			
From Great Britain ...	34,844	17,481	— 17,363
„ Germany ...	22,936	10,377	— 12,559
„ United States ...	23,287	10,699	— 12,588
„ Other countries ...	1,213	—	— 1,213
Total	82,280	38,557	— 43,723
Electric Ventilators.—			
From Great Britain ...	10	3,298	+ 3,288
„ Germany ...	140	507	+ 367
„ United States ...	—	3,040	+ 3,040
„ Other countries ...	—	150	+ 150
Total	150	6,995	+ 6,845
Boilers, Steam Generators, &c., for Mines.—			
From Great Britain ...	320,341	195,050	— 125,291
„ Germany	8,884	61,218	+ 52,334
„ United States ...	14,100	19,576	+ 5,476
„ Other countries ...	88,388	—	— 88,388
Total	431,713	275,844	— 155,869
Machines, Apparatus and Parts, for Mines.—			
From Great Britain ...	8,111,024	6,090,869	—2,020,155
„ Germany	2,224,892	2,074,911	— 149,981
„ Belgium	14,000	162,977	+ 148,977
„ United States ...	191,299	274,514	+ 83,215
„ Other countries ...	—	19,478	+ 19,478
Total	10,541,215	8,622,749	—1,918,466
Cranes, &c.—			
From Great Britain ...	261,832	262,312	+ 480
„ Germany	41,897	40,748	— 1,149
„ United States ...	1,466	8,751	+ 7,285
„ Other countries ...	13,324	1,567	— 11,757
Total	318,519	313,378	— 5,141
Electrical Machinery, Apparatus and Accessories.—			
From Great Britain ...	71,382	164,369	+ 92,987
„ Germany	481,788	434,395	— 47,393
„ France	10,003	1,679	— 8,324
„ United States ...	141,676	37,531	— 104,145
„ Argentina	—	12,972	+ 12,972
„ Other countries ...	200	926	+ 726
Total	705,049	651,872	— 53,177
Machinery and Accessories for Electric Lighting.—			
From Great Britain ...	228,092	720,293	+ 492,201
„ Germany	223,295	553,305	+ 330,010
„ France	1,235	14,014	+ 12,779
„ United States ...	308,501	309,992	+ 1,491
„ Other countries ...	2,707	4,455	+ 1,748
Total	763,830	1,602,059	+ 838,229
Machinery, Apparatus and Parts for Industry in general.—			
From Great Britain ...	1,870,609	2,841,194	+ 970,585
„ Germany	1,444,117	2,001,767	+ 557,650
„ France	139,254	170,052	+ 30,798
„ Belgium	31,876	193,396	+ 161,520
„ United States ...	408,870	729,682	+ 320,812
„ Other countries ...	68,289	36,234	— 32,055
Total	3,963,015	5,972,325	+2,009,310
Motors.—			
From Great Britain ...	1,788,685	3,082,113	+1,293,428
„ Germany	214,955	475,295	+ 260,340
„ France	48,919	57,237	+ 8,318
„ United States ...	35,684	242,941	+ 207,257
„ Other countries ...	34,418	14,237	— 20,181
Total	2,122,661	3,871,823	+1,749,162

N.B.—Peso = 1s. 6d.

Key-Holder.—Messrs. A. Garston & Co., of Aldersgate Street, E.C., are supplying the "Imperial Key Pocket"—a pigskin purse-shaped pocket, in which are a dozen numbered straps with fastenings, on which keys, and perhaps some other articles, may be hung. It strikes us as being a very convenient device for keeping keys available and clean, without their getting into a bulky cluster and wearing out one's pocket, and for finding the right one when in the dark and perplexed. The pocket having been adopted in domestic service and some trades, the inventor thinks that electricians might with advantage make use of it.

AUTO-TRANSFORMERS FOR METALLIC-FILAMENT LAMPS.

By J. L. CATEAUX, A.M.I.E.E.

Auto-transformers enable the pressure of supply on alternating current systems to be reduced at the consumer's premises to a suitable lower voltage, so that the maximum advantages may be obtained from the use of metallic-filament lamps.

It is generally desirable that the pressure should be transformed to either 25 volts or 50 volts in order that metallic-filament lamps may be used throughout.

Twenty-five-volt metallic-filament lamps are obtainable in units of 10 c.p., 16 c.p. and 25 c.p., and they have an efficiency of about 1 watt per c.p., so that these lamps very conveniently replace the standard carbon filament lamps of 8 c.p. and 16 c.p., and the consumer is able to obtain the equivalent illumination or a little more, with about one-quarter to one-third of the current consumption.

The 25-volt lamps have small bulbs, burn in any position, and are generally much less fragile and more efficient than higher voltage metallic-filament lamps.

Fifty-volt metallic-filament lamps are obtainable in units of 16 c.p., 25 c.p. and 32 c.p., and it is usual to adopt this voltage in cases where it is desired to obtain a higher degree of illumination than is given by the 25-volt lamps.

The list price of the 25-volt lamps is 3s. to 3s. 6d. each, and of the 50-volt lamps, 4s. each, so that they are cheaper in first cost than the high-voltage filament lamps, and this fact, combined with their longer life, makes an appreciable reduction in the cost of renewals.

By the use of auto-transformers the necessity for fitting series adaptors for metallic-filament lamps is entirely superseded, and the consumer need not have two lamps alight where, in many cases, a single lamp is sufficient for his purpose. Apart from the cost of the adaptors and the trouble of getting lamps to match each other for burning in series, the consumer is compelled to have either double or four times the light which he probably requires, and, moreover, he cannot at present obtain small enough units to enable him to use metallic-filament lamps throughout, as it is obviously out of the question to replace 8-c.p. carbon-filament lamps in passages, lavatories, &c., with metallic-filament lamps of 25 c.p. and over.

In selecting an auto-transformer, particular attention should be paid to its efficiency, close regulation and open circuit losses; these latter, which are continually going on for 24 hours per day, have a very marked effect upon the annual consumption of current, and with inefficient transformers they may easily wipe out a large proportion of the saving effected by metallic-filament lamps.

In the case of a new installation, either 25 volts or 50 volts may be selected, according to the candle-power of the lamps which the consumer desires; but when the auto-transformer is put into premises which have already been wired, it is necessary to consider the current-carrying capacity of the conductors.

Generally speaking, when the premises are already wired, it will not be safe to adopt a ratio of transformation greater than 4 : 1, as this will give about the same load in amperes as would be allowed for in the first instance for carbon filament lamps.

In installations which have been wired for 200 volts, transformers for 50 volts on the secondary side should, therefore, be used, and for installations which have been wired for 100 volts, transformers with either 50 volts or 25 volts on the secondary side may be adopted.

It is advisable, if possible, to arrange an installation with a minimum of two, four, or eight circuits, on which a fairly equal number of lights is likely to be in use, as by this method a transformer of smaller output can be used; the size being dependent upon the maximum out of balance load. If the ratio of transformation is 2 : 1, two secondary circuits are sufficient, but with ratios of 4 : 1 and 8 : 1, four or eight secondary circuits respectively are necessary on the auto-balance principle, the auto-transformer being supplied with the equivalent number of terminals on its secondary side.

The following is a typical example of the cost of using metallic-filament lamps and an auto-transformer, compared with ordinary carbon-filament lamps. Assuming a private house with 50 16-c.p. and 24 8-c.p. lamps :—

Cost of carbon-filament lamps at 1s. each...				£3	14 0
Cost of 25-volt metallic-filament lamps at 3s. each	£11	2	0		
1-kw. high-efficiency auto-transformer ...	3	0	0		
				14	2 0
Extra initial outlay				£10	8 0

Assuming that the consumption of current will be equivalent to the whole of the lamps being in use one hour per day throughout the year :—

Annual cost of current at 4½d. per B. of T. unit for carbon-filament lamps, will be	£27	0	0
Ditto for metallic-filament lamps	7	0	0
Annual saving	£20	0	0
Deduct open circuit losses in high-efficiency transformer at 4½d. per B. of T. unit	2	0	0
Net annual saving	£18	0	0

It will be seen that the extra capital outlay for the high-efficiency transformer and metallic-filament lamps is paid for in the first year, and leaves a surplus balance of £7 12s.

After the first year, and allowing for the extra cost of renewals at 3s. per lamp, as against 1s., the net annual saving will be at least £15 10s.

In the case of shop lighting, office lighting, &c., where the lamps are turned on at dusk, and turned off at closing time, a switch should be fitted, so that the transformer can be switched off at closing time, and switched on again when light is required the following day; by doing this the open circuit losses will be a negligible quantity, and the maximum saving in current consumption will be obtained.

THE LAST CENTURY'S CONCENTRATION.

By "WREN."

The past century has seen many changes in the scientific and engineering world; in fact, one is tempted to say practically all the changes. Perhaps of these, the most noticeable tendency is that towards compactness.

Every piece of apparatus and machine is now made and worked far more *intensely* than was the case even 20 years ago. The introduction of high-speed machinery has made great compactness possible, and in turn has made it *essential*, in order that the materials employed may stand the huge centrifugal stresses consequent on the high angular velocity.

The radius of the mass centre of the rotor has been continually diminished. In some cases (as in traction work) a small radius of gyration is necessary in order to maintain a low moment of inertia of the rotating parts, and so make high accelerations more readily obtainable. In traction practice, however, the chief influence towards concentration has been the necessity of providing an immense horse-power (for rapid acceleration) in a very limited space.

Besides the above physical reasons, we have to consider that potent factor—economy of manufacture; and, though the manufacturing cost of high-speed machines is greater in some respects than those of slower units, yet the vast saving in space and material usually outweighs this increase.

In the realm of electricity the first step towards concentration was the replacement of primary cells by dynamo-electric machinery as the source of electrical energy. At the present day it is possible to stand in many central stations and see side by side the early rope-driven generators, each unit only of several hundred kw. capacity, huge fly-wheel alternators, their juniors by a few years only, and the latest addition to the lists of progress—the steam turbine—it and its generator hardly taking up more room than the dynamo alone of the earliest sets, though its capacity may be twenty-fold.

Considering the chief commercial economies consequent on the decrease in size of electric generators and motors—

1. *Economies in Materials are:* (*a*) Less field iron and armature iron, and hence less cost of raw material and manufacture (the latter including depreciation charges, &c., on the operating tools).

(*b*) Less exciting copper required because (1) of the shorter magnetic paths; (2) of the shorter length of mean turn round the smaller pole cores; (3) of the smaller armature length and diameter.

(*c*) Less insulation cost, since the square inches of conductors to be covered is less.

(*d*) Less commutator weight (usually a very important economy).

2. *Floor Space is Saved.*—Again no mean economy, in cities such as London.

The means by which these concentrations have been effected are too well known to need repetition; carbon brushes, forced ventilation and improved magnetic and electrical materials have all had their influence. The advances, however, have not been due to engineers alone: chemists, in their new irons and steels, have produced materials which, in one application, can be run at the enormous peripheral speed of the De Laval turbine, and which in another can be run at abnormal flux densities with a minimum of exciting copper and with extremely low hysteresis and eddy current losses.

On the switchboards of a central station one has further remarkable instances of concentration. Thousands of horse-power are controlled with perfect safety by switches occupying only a few square feet of the board. The early horn break switches, and plug switches (in which the plug, hurled over the operator's shoulder on removal from its socket, was followed by an arc for some distance, at considerable risk to the attendant) have been replaced by oil switches, the simultaneous gain in compactness and safety being enormous.

The concentration, or "centralisation," of generating units is but another example of the trend of modern practice.

Not only in large machines has radical concentration occurred, for in galvanometers and other instruments, operated by milli-amperes instead of by hundreds of amperes, the same tendency is to be found. Again, the object is to reduce the moment of inertia of the moving parts, and so to enable infinitesimal currents, hardly capable of detection a few years ago, to produce any desired effect (by aid of relays).

In instruments the concentration is practically always with the view to obtaining increased delicacy, and the limits to which the concentration has been pushed cannot be better illustrated than by reference to the measurement of telephonic voice currents. This measurement depends almost essentially on the concentration of a resistance of 100-200 ohms within a thin plate of only a few sq. mm. area, this acting as the heater of a thermo-couple.

Though the examples of compactness in the instruments of a modern testing laboratory can only be described as miracles of ingenuity and construction, more obvious, and possibly more generally serviceable examples are to be found in the larger apparatus already mentioned.

Progress is by no means confined to the electrical industry; the advances from the beam engine to the torpedo craft engine, from the early mining pump to the modern turbine pump, lifting ¼ million gallons per day, through a height of hundreds of feet, are surely strides vast enough to defy contradiction.

Forced draught enables the combustion of 140 lb. of coal per sq. ft. of grate area instead of 16 lb. per sq. ft., a corresponding increase in the output of a given size of boiler being obtained. Examples could be indefinitely multiplied, but food for thought has already been provided.

On every side the tendency is towards high speed, high pressure, lightness, and economy. Idle material is practically eliminated, and the place once occupied by a massive casting is now occupied by its steel lattice substitute, and an auxiliary pump or motor to boot. Compactness has not been obtained at the expense of reliability however; indeed, under modern conditions, the latter is more essential than ever.

Many branches of engineering are still undeveloped owing to our present inability to sufficiently *concentrate* our agencies in these branches. Thus electric automobiles only await the sufficient concentration of the storage cell or that infinitely more desirable concentration, the wireless transmission of power. Again, millions of H.P. await concentration in the power of the tides and of aerial electricity—perhaps these shall afford the 20th century solution to the failure of the coal supply (which, after all, is the ultimate source of all our present energy concentrations).

Mere reference may be made to the fact that in the human element the same trend is visible—there have been great concentrations in the scope of each man's labours—in some cases too great, it is to be feared.

The skilled workman has become practically a machine, while, on the other hand, manufacturing machines have been endowed with almost human discrimination.

The terrible concentration of working space in factories, &c. (so interlinked with the early years of the past century) has, fortunately, been largely relaxed, partly in consequence of compulsory legislation, partly by voluntary reform by the manufacturers themselves.

Undoubtedly one of the aptest watchwords of the past century would be "Concentration": and though ten years' progress scouts the possibility of "Finale" in engineering advances, one cannot but wonder what material and what workmanship will prove equal to the concentrations which must inevitably continue.

A BREAKDOWN AT A GENERATING STATION—A LEGAL VIEW.

The recent accident which suspended traffic on the District Railway for a short period appears to have turned public attention to the question how far an electric supply company is liable in such circumstances. Sudden failure is, of course, disastrous. The longer the supply has been constant, so much the more serious does a breakdown become: for people have learned to trust implicitly to electricity for light and motive power.

The extent of the damage caused by two recent breakdowns was thus described by Mr. C. Newton Russell in a letter addressed to the *Daily Telegraph* of October 12th. He pointed out that by a breakdown at the Greenwich power station of the London County Council, 600 to 800 tramcars were brought to a standstill. The Lot's Road breakdown stopped all the trains and lifts on the Bakerloo, District, Piccadilly, and Hampstead Railways, all these lines being plunged in utter darkness. It also caused a stoppage on the Wimbledon and Surbiton sections of the London United Tramways.

What, if any, is the remedy for this? Have the public any redress? To provide an answer to this question one must first consider whether these companies and the County Council are liable to penalties if they cease to run trains and cars. Having answered that question in the affirmative, the further point will arise as to whether they can be liable to penalties for what may be an evitable accident.

We have not got before us the text of the Acts under which the companies responsible for the underground railways, and the County Council, respectively, are entitled to use electricity as a motive power. We fancy, however, that upon general principles, even assuming that they were under statutory obligation to keep trains and tramcars constantly running, they could not be held responsible for unavoidable stoppage. Another branch of the law relating to electricity assists the solution of the problem.

Turning to the Acts which deal with the supply of electricity for lighting purposes, we find that the possibility of accident has been specially foreseen. The Electric Lighting Clauses Act provides that whenever the undertakers make default in supplying energy in accordance with the terms of the Board of Trade Regulations, they shall be liable to such penalties as are prescribed in the Regulations in that behalf. These penalties may be recovered summarily. The effect of the clause imposing them is to impose a duty on every electric lighting company to keep up a constant supply. But they are not to be held liable in every case of stoppage. Thus there is a proviso to the effect that the penalties to be inflicted on the undertakers must in no case exceed in the aggregate the sum of £50 in respect of any defaults not being wilful defaults on the part of the undertakers for any

one day, and provided, also, that in no case shall any penalty be inflicted in respect of any default, if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply.

What, then, is inevitable accident? It was decided some years ago in Dublin that the burning-out of a cable was an inevitable accident, from the consequences of which the company were entitled to be excused. That seems to us to accord with justice and good sense. But the question whether the fusing of a cable is an "inevitable accident" may well arise at some future time. If a company with a view to saving the expense of a new cable were to deliberately overload an old one, an accident arising from this cause could not be looked upon as inevitable. Again, suppose that a company were imprudently to add to their list of consumers without making a corresponding increase at the generating station, damage arising from overloading would not be caused by an accident. As to *force majeure*, that refers to something which no man can guard against, such, for instance, as a flood, an earthquake, or a subsidence which severs the cables.

With regard to breakdown due to increase in the number of consumers, there is only one case which throws a somewhat dim light upon the question. This is Marylebone Vestry *v.* Metropolitan Electric Supply Co., which was heard in January, 1900. The company was summoned for making default in supplying energy to the workhouse and Vestry premises on certain days. The company admitted the default, but contended that the same was due to inevitable accident caused by the great increase in the demand for electricity, which had exceeded its expectations. The case was adjourned for three months, and was not heard of again. Later on, however, the same company was fined at the instance of the London County Council for making default in the supply of electricity to the houses of certain individuals.

From the facts which have already been made public, it would seem to be clear that the breakdown at Lot's Road came under the head of inevitable accident. It would follow, therefore, that even supposing the companies concerned were bound to keep their trains continually running, they could not have been held responsible for the temporary stoppage.

THE SMALL STATION AND ITS ECONOMICAL OPERATION.

[CONTRIBUTED.]

A recent issue of the New York *Electrical Review* contains an abstract of a paper on the above subject by Messrs. J. I. Whittlesey and Paul Spencer. After laying down certain hard and fast lines on which they consider a small station should be designed, the authors proceed to discuss methods of managing it.

They take as their basis a station to cope with a maximum load of 600 kw. in the first year, increasing at the rate of 10 per cent. per annum (compounded) to 1,558 kw. at the end of 10 years. Although by no means a large station, this certainly is as large as one finds in many towns in this country of quite fair size, and a large number of far less capacity are more or less successfully run.

The authors' design for such a plant is on the lines of omitting everything that is not absolutely necessary, and so curtailing the capital expenditure as far as possible. They also propose to omit certain items which make for economy in generation, but which, in their opinion, involve extra expenditure in upkeep and repairs.

The station is to be designed to generate and distribute polyphase alternating current at 2,300 volts and a frequency of 60. The site is to be all that one could hope for: ample space, close to the centre of the town (somewhat contradictory conditions in this country as a rule), with a plentiful supply of condensing water and a railway siding, and so forth. Coming to the engine room, they remark that a crane is "desirable, but not necessary," and for the first few years they would run non-condensing. It should be noted that the first sets are to be 300 kw. and later ones 500 kw., all low-speed single-cylinder engines, and therefore, one would think, somewhat bulky to deal with without a crane. Water-tube boilers would be installed, fitted for hand-firing; and with the necessary feed pumps, feed heaters

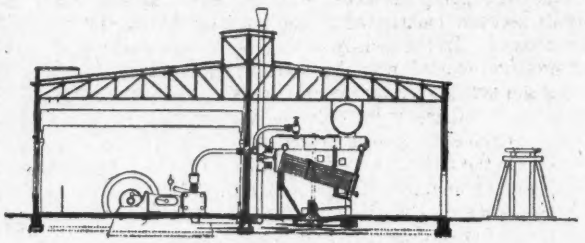

Fig. 1.—Section of Proposed Plant.

and belt-driven exciters, the list of plant practically closes. An economiser is not to be installed. Figs. 1 and 2 are an elevation and plan of a station designed on these lines. It will be noticed that the overhead crane is, after all, included in the drawings. The initial plant only is shown in full, the remainder being dotted. The first year's maximum load being 600 kw., three 300-kw. sets are installed to start with, and two 500-kw. sets are added subsequently. The load

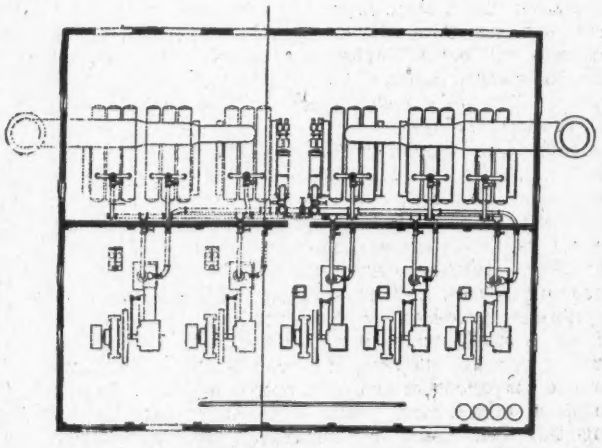

Fig. 2.—Plan of Proposed Plant.

factor is set down at 25 per cent. A first year's load curve is shown in fig. 3.

The authors' idea appears to be that the station is too small to keep a competent fitter, and that everything that

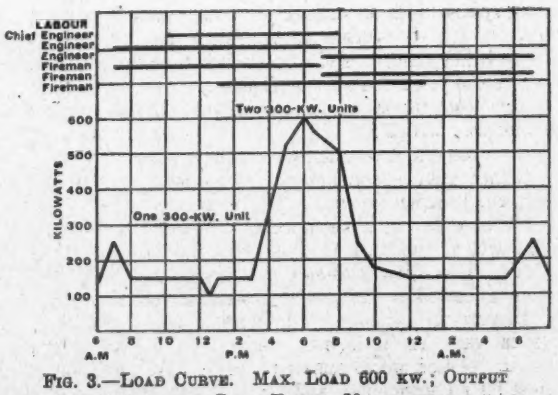

Fig. 3.—Load Curve. Max. Load 600 kw.; Output 5,576 kw.-h.; Load Factor 38 per cent.

would be likely to involve any great amount of repairs should be omitted. Apparently it is partly for this reason that the steam pressure is limited to 120 lb. The omission of condensers, mechanical stokers, forced draught, &c., is represented as lessening greatly the time to be spent on repairs,

thus enabling the staff to devote more time to maintaining the engines and boilers in a state of efficiency.

The staff is now detailed. It consists of six all told. In the engine room there are a chief engineer and two running engineers. Translated into English, this probably means a fitter-driver and two drivers, each of whom looks after the engines and switchboard, the former taking the afternoon shift and overlapping his second over the peak. During the intervals between looking after the running, he attends to minor repairs. In the stokehold there are two stokers, and one "fireroom helper," who also takes an afternoon shift and overlaps the evening stoker over the peak. All this is quite workable, but rather a tight fit. In this country there are usually a couple of improvers in the engine room who take it in turn to do the day-shift, while the fitter-driver is engaged on repairs. The authors next proceed to detail the means by which economies can be effected in generation costs, which, however, are too obvious to need repetition, and they conclude with a table of costs which look rather more like paper figures than real ones, and are, therefore, hardly worth criticising. Suffice it to say, that for the first year's working, with an output of 1,320,000 units, a peak load of 600 KW., and a day-load of 150 KW., with 300-KW. single-expansion sets, non-condensing, coal at $3, &c., the total works costs are given at 1·3917 cents per KW.-hour (note the four decimal places), or, say, ·7d. per unit.

Although there is much in this paper that is hardly likely to find endorsement by station engineers in this country, it raises many points which provide ample food for thought. It will be noted, in the first place, that the authors take it for granted that a three-phase supply at 2,300 volts will be given, and they state with even greater emphasis that the frequency will be 60. Where alternating current is to be used, the standardisation of frequency, as well as the distributing voltage, is a matter greatly to be desired, but the slavish adoption of one system of supply without regard to the needs of the district is hardly to be recommended. It would appear from the paper that the system indicated is as universal in the States as three-wire continuous-current distribution is in this country, or as single-phase alternating current was there a few years ago. So fascinated are we with the charms of the three-wire system that we install it even in straggling country districts, with no possible chance of an appreciable motor-load. A country supply area consisting of, say, a small country town surrounded by villages and small residential districts, if supplying L.T. continuous current, has perforce to confine its operations to a radius of a couple of miles at most. Many such stations could largely augment their load by connecting the neighbouring residential districts each with its sprinkling of good-sized houses, as well as many large country mansions that otherwise are compelled to run a private plant, by means of overhead wires if the supply were H.T. three-phase. It seems that we must have three-wire D.C. distribution everywhere, and when we want to distribute over large areas, we must generate and transmit three-phase, and use transformers and rotaries to get back to our pet system of distribution. On a big system with a substantial power load it is right enough, though the system seems rather too roundabout for one to believe that it is the final solution of the problem. But where the power load must of necessity be insignificant, and where the district is scattered, why not three-phase generation *and distribution?*

Then we come to the question of the omission of such extra refinements as condensers, economisers, mechanical stokers, &c., in small stations. The plant mentioned in the paper under review is, in the opinion of the present writer, dealing with a load that justifies some further auxiliaries than the authors allow, although the extent to which such refinements should be pushed for a particular station is one that can only be judged by very careful consideration of individual cases on their own merits. The plan in the station in question would appear to be to make provision in the flues for an economiser, and allow space in the engine room for condensing plant, so that these can be added after the first few years when the load has increased sufficiently to justify them, and when actual experience of the running costs has enabled the engineer to estimate the saving that would be made by their adoption. This saving can then be balanced against the extra capital charges and additional cost of upkeep. Given a plentiful supply of good water, excellent results can be obtained for quite a small capital expenditure by installing jet condensers.

The present writer does not believe that the station cited would be run for many years with a fitter-driver taking the day shift, but, on the other hand, he does not believe that the repairs on chain grates and condensers and their attendant auxiliaries would necessitate any further cost in labour for upkeep than would be entailed by keeping a fitter on repairs only, and replacing him on day shift by an improver. Neither has he found that good compound high-speed engines are any more trouble to keep going than single-cylinder low-speed ones. As to mechanical stokers, from the point of view of labour saving, they have no advantage in a small station, but if of a type, such as the chain grate, that enables one to get as good results with a cheap bituminous slack as can be got with a large coal hand-fired at 50 per cent. higher cost, then it will pay to install them at the start.

So much for the size of station selected by the authors of the paper; but if one is putting down plant for a very small place to cope with an ultimate maximum load of only a few hundred kilowatts, it is quite a question whether it does not pay best to dispense with steam plant altogether and put in Diesel oil engines, thus reducing labour charges to a minimum, and at the same time getting far lower fuel costs than can be obtained with such an uneconomical plant as the authors advise. There is a small station not 100 miles from London where the maximum load, after six years' working, is under 100 KW., and which last year generated only just over 100,000 units, but which, with Diesel oil engines, is generating for under ·3d. per unit for fuel.

Taxation of Electricity in Germany.—It is now a few months since we drew attention to two schemes which were attributed to the German Government as expedients which might possibly be resorted to, in order to raise additional revenue to meet the growing expenditure of the country. The first referred to a nebulous project for nationalising the electricity supply business either with or without the manufacturing industry, while the other related to the suggested imposition of a tax upon the supply or use of electricity. Although serious doubts have been entertained as regards the official intentions as to the first mentioned, more credence has been attached to the possibility of the introduction of an electricity tax. In this connection a little light has been thrown on the problem in general by the proceedings which took place at a meeting of the Finance Committee of the Lower Chamber at Munich on June 23rd. The Minister of Finance, interpellated on the question of an Imperial electricity tax, explained that he was placed in a difficult position. He had that day received the schemes from the Imperial Secretary to the Treasury; they were of a confidential character, and he could not discuss them under the circumstances. Dr. Pichler thereupon requested the Minister to take care with the greatest determination that Bavaria should be preserved from the injury of an electricity tax; and he added that the Bavarian Government had the people's representative assembly united at its back in resisting the plans of Berlin. Dr. Hallor, who submitted that the explanation given by the Minister rendered it possible to read sufficiently between the lines, said that the Minister should combine with his South German colleagues in decidedly rejecting the threatened Prussian plans. It will be observed that the Minister referred not to a scheme but to schemes. Of course these may merely represent alternative proposals having in view a tax on electricity, but the fact that they exist clearly shows the way the wind is blowing from the Prussian camp. It is, however, extremely doubtful whether Bavaria will consent to any such project, because its enactment would place a financial burden on this State, having regard to the determination to nationalise the Bavarian waterfalls in connection with the contemplated transformation of certain of the railways to electric traction. Not only so, but Bavaria desires to attract manufacturing industries which would be supplied with State electricity, and more than one important firm has been prevented from acquiring possession of water powers for the establishment of factories, by the resolve of the Bavarian Government to be the first in the field. Bavaria and Prussia in opposition to each other, is certainly a new feature, with unlooked-for possibilities in the future.

S.O.B. Dinner.—The Annual Re-union of the S.O.B., which is an informal Association of the men who served their apprenticeship at the Acton Hill Works (Scott's), was held at the Manchester Hotel, London, on 3rd inst. Members from all parts of the country attended, and great enthusiasm marked the proceedings. Many met for the first time for 20 years. A pleasant surprise consisted in the reproduction on the menu of a photograph taken in 1887, representing some of those present, now prominent members of the electrical profession.

GERMAN TURBO-GENERATORS.

[BY OUR BERLIN CORRESPONDENT.]

The adoption of high-speed generators directly coupled to steam turbines has resulted in something like a revolution in the construction of electrical machinery, and marks an epoch in the evolution of the electrical industry.

While at least the equal of the reciprocating engine, so far as the cost of operation is concerned, the steam turbine possesses a number of advantages over its older rival, viz., smaller space requirements, less weight and the absence of any reciprocating parts and cranked mechanism.

While the relatively high speed of rotation of steam turbines afforded a decided advantage to the electrical industry, reducing the dimensions of the generators as compared with their output, it nevertheless resulted in a number of new problems, a solution of which could be found only after prolonged experience. Owing to the enormous centrifugal force, only high-grade material could be used, while specially skilled labour was required to produce an efficient turbo-generator. Another problem connected with the construction of turbo-generators was to provide for adequate cooling, to compensate the very considerable heat evolution. The rotary part of the machine (also with a view to the centrifugal force) is of small diameter, resulting in a very compact design and small cooling surface. Artificial cooling was therefore found to be indispensable. The Siemens-Schuckert turbo-generators are for this purpose entirely enclosed, with the exception of a few parts, such as the commutator and slip rings, while part of the front surface of the rotor has been designed as a ventilator. These turbo-generators are therefore also protected against the introduction of foreign bodies, while any accidental contact with current-carrying or rotating parts (unless they have to be accessible for the sake of operation) is effectively avoided.

In the case of single-phase or three-phase current turbo-generators (fig. 1), the rotor, as in the case of low-speed machines, carries a field-magnet coil, which, in order to avoid noise due to the high speed of rotation, is designed as

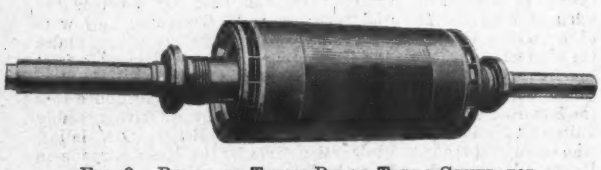

Fig. 2.—Rotor of Three-Phase Turbo-Generator.

a cylinder (fig. 2). The coil, which is embedded in slots, is secured against the effect of centrifugal force by metal wedges in the slots and by metal caps at the ends. The exciting current is supplied to the rotor through carbon brushes. The alternating-current coils, insulated with micanite tubes, are anchored at the ends.

The continuous-current turbo-generators (figs. 3 and 5) are provided with alternating poles, and if required with a compensating coil located in the pole-pieces of the main poles. The effectively ventilated armature (fig. 4) carries a former-wound coil secured against the effects of centrifugal force by wedges and bronze caps.

Carbon brushes are used with a view to avoiding, as far as possible, any sparking, while simplifying operation. The commutators are ventilated by a strong air current, as well as by means of air channels arranged in the segments, or by special provision for heat radiation and conduction.

The turbines, constructed on the Zoelly system, are pure multiple-stage action turbines. In order to ensure moderate speeds of steam flow, these turbines are provided with nine to ten stages as a minimum, so that the speed of the steam can be reduced below 400 m. per second. The vanes are thus subject to practically no wear. The turbines are provided with either a single casing or separate high and low-pressure casings.

The guide rims are made of two pieces of steel or grey cast-iron with holes for fitting the vanes, which are fixed by means of double rings. The safety of the running wheels is specially noteworthy, and largely accounts for the satisfactory

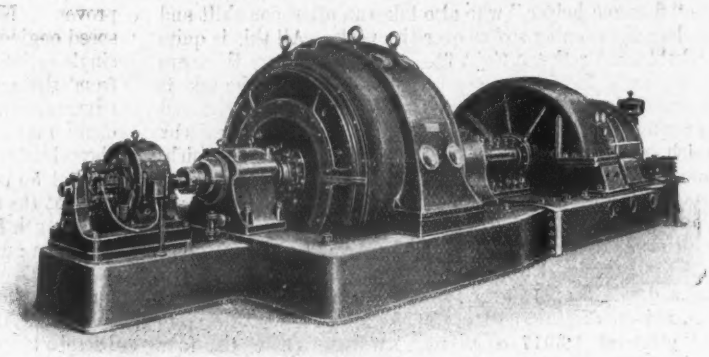

Fig. 1.—Three-Phase 6,250-K.V.A. Turbo-Generator.

results obtained from these machines. The disks are forged with the hub from a block of first-class steel. The thickness of the disk increases from the rim towards the hub so as to obtain a body of practically uniform mechanical strength.

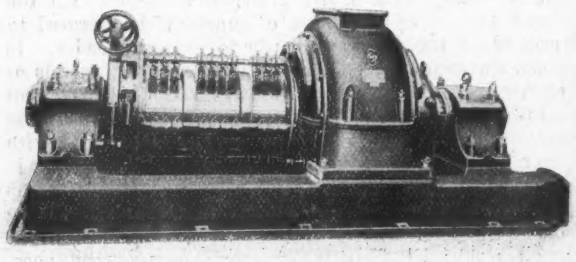

Fig. 3.—D.C. Generator for 110 Volts, 1,135 Amperes, at 3,000 R.P.M.

The rim is designed with a view to receiving the vanes and is provided with a circular slot, as well as a projecting central ledge, against which a slotted ring is applied. These two slots situated opposite one another then form a continuous groove into which the vanes and intermediary steel blocks are fitted. The vanes themselves are made of nickel steel with walls

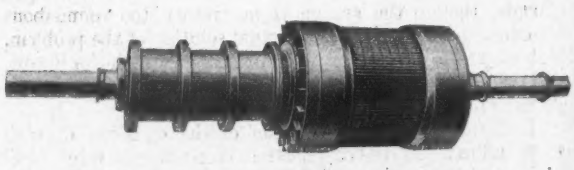

Fig. 4.—Armature of D.C. Turbo-Generator.

increasing in thickness from top to bottom, so as to produce a body of constant strength, resulting in a very uniform and low stress on the material.

In order to reduce thermal losses, the casings and their front surfaces are surrounded with insulating material, with a sheathing of black polished sheet metal. The base plate of the turbine is keyed to the generator bed by means of substantial bolts.

The bearings are lubricated by a central lubricating system, and the stuffing boxes are designed on the principle of labyrinth packing. Regulation is obtained indirectly through the intermediary of a pilot motor.

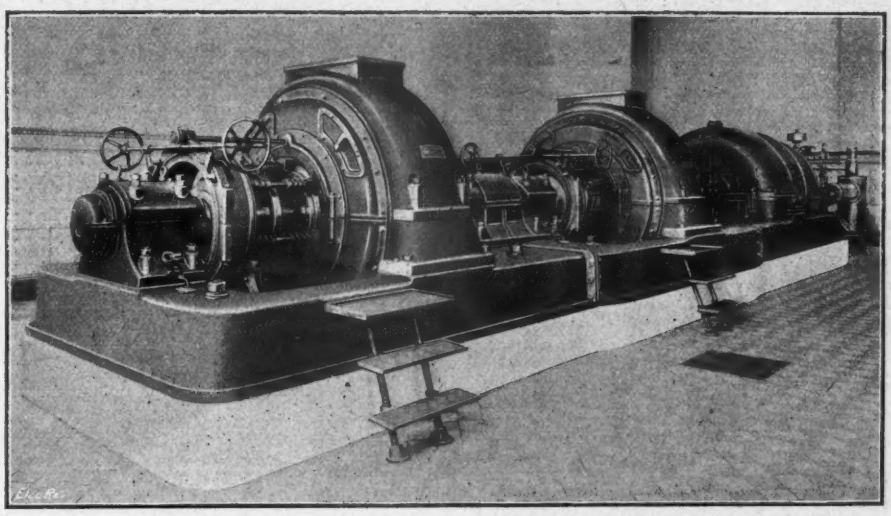

Fig. 5.—Two D.C. Generators for 400—600 Volts, Coupled in Tandem to a Turbine of 1,950 h.p.

A special feature of these turbines is the small number of vanes, which is only one-third to one-fifth of the number of vanes contained in a multiple-stage reaction turbine of the same output and speed of rotation.

THE LOT'S ROAD BREAKDOWN.

We referred in our last issue to the accident which recently occurred at the Lot's Road power station of the Underground Electric Railways Co. of London. For the following detailed account of the matter we are indebted to Mr. James R. Chapman, the chief engineer of the company :—

At 2.45 on the afternoon of Saturday, October 3rd, with five 5,500-kw. turbo-generators in service, all carrying approximately full load, one phase was suddenly earthed, bringing into action all the static dischargers and other safety devices in the house, and making it necessary to trip the circuit-breakers on the exciters and thus shut down the generators and the 26 sub-stations supplied therefrom.

This brought all trains and lifts to a standstill on the Bakerloo, Piccadilly and Hampstead Tube Railways, as well as on the District Railway and the Wimbledon and Surbiton sections of the London United Tramways.

A review of the whole situation indicates that the initial cause of the trouble was a "short" between the primary and secondary windings of a series transformer on one of the conductors between the generator and its oil switch. These transformers, of which there are, of course, three on each generator, are about 8 in. in diameter and 10 in. long; ratio, 100:1; normal load, 300 amperes. Their secondary extends to the control board, and actuates the ammeters, wattmeters, &c., thereon. Each transformer is placed in a brick compartment with one open side, so that if a failure occurs there is ample room for the arc to escape. Such transformers are necessarily weak, and have failed before both in the generating station and in the sub-stations. They have what might be described as a squirrel cage form of winding, and are accurate within ½ per cent. at all loads. This essential accuracy requires the coils to be very close together, thus increasing the risk of breakdown. The frames of these transformers, and one point in the secondary leading to the control board, are earthed. The copper earthing strips in the Chelsea generating station are of very large capacity, and, of course, it only took a few seconds to develop sufficient internal pressure in the transformer to cause it to explode. After passing through the transformer, the machine cable is carried vertically through porcelain insulators in the concrete floor above and into brick compartments containing the oil switch. In this instance the force of the explosion drove the arc and flame up through the insulators, thus short-circuiting the cables leading to and from the base of the oil switch. The opening of this switch failed to disconnect the machine cables from the bus-bars. This bus-bar is divided into five sections, and oil switches of large capacity couple these sections. The surge of current, however, owing to the earthing of one phase, was so great that a number of the static dischargers on the feeder cables were over-taxed and bridged, so that it became necessary to completely shut down in order to clear up the earth connections through the safety devices. The total damage done was trifling; even the oil switch above the transformer was ready for service the next morning, and there were enough spare turbo-generators to carry the whole load, and the isolating switch blades were simply opened on the damaged oil switch. It took some little time, however, to clear up the earth connections on the 186 static discharge panels and thus make sure that it was safe to again put 11,000 volts on the bus-bars. Two similar series transformers failed on feeder cables, and one feeder oil switch, out of 33 that were in service at the time, was slightly damaged.

All sub-stations are supplied through duplicate cables, and, of course, the first supposition was that such a heavy surge might have damaged the cables which were in service, hence all sub-stations were started with the cables which had not been in service at the time of the accident. The rotary converters in nearly all the sub-stations were reversed, hence, generally, the load was taken by the machines which were previously idle, and the polarity of the other machines was thus made normal. A few rotaries flashed over, but that was the extent of the damage in the sub-stations. On the 357 miles of three-phase cable leading to the sub-stations, there was not a single failure.

There were no personal injuries of any kind, either in the generating station or in the sub-stations.

The accident proves that 2½ ft. of free air space and a 6-in. concrete floor are not sufficient between one of these series transformers and the oil switch, hence this will be increased to 8 ft. Further, that all space between the cable and the inside walls of the insulator should be caulked tight, and with a view of limiting the field of influence when one of these little transformers fails, they will be enclosed in a somewhat larger brick chamber with one side open as at present.

The neutral point of all the generators is earthed through a cast-iron grid resistance of about 7 ohms resistance and 2,000 amperes capacity.

The static discharge panels are each 5 ft. long, and have eight gaps of ·0047 in. each, and a carbon resistance rod ¼-in. diameter and 33 in. long, its resistance being ·375 megohm.

Lignite as Central Station Fuel.—The production of brown coal or lignite in Germany has already reached a total of nearly 60,000,000 tons per annum, and a large quantity of the tonnage is converted into briquettes. Now, however, two schemes are in progress for the utilisation of lignite as fuel in place of pit coal for the firing of boilers in central stations. In the first case the Bavarian Overland Central Station Co. has just been formed at Regensburg with a share capital of £125,000 for the erection of a generating station on the site of the Haidhof lignite mines in the Upper Palatinate, which have hitherto belonged to the well-known coal firm of Matthias Stinnes, of Mulheim. The latter firm has taken up a large interest in the company, and the Bergmann Electricity Co. has subscribed £30,000, and has obtained the sole right of supplying the machinery and plant for the station, which is to commence work within a year. It is intended to supply electrical energy over a large area, and 40 agreements with communes and factories have already been concluded, those with the local authorities being for an average period of 25 years; whilst the town of Regensburg, which is 21 miles distant, is also included in the scheme. It appears, however, that the latter part of the project would clash with the second scheme, which concerns the preliminary works commenced by the Siemens-Schuckert Works Co. in conjunction with the Bavarian Lignite Industry Co. for the utilisation of the latter's lignite mines at Schwandorf for a similar purpose. In this instance it is intended to erect a generating station at the mines, with the object of supplying the existing Siemens-Schuckert generating station at Regensburg, which is loaded to its full capacity, and is unable fully to satisfy the demand. It is assumed that the Schwandorf station would also cater for custom in the neighbouring localities, and the question is therefore being asked as to whether there is room for the two lignite power stations in the region concerned.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

20,300. "Improvements in telegraphic relay." I. Kitsee. September 28th. (Complete.)

20,332. "Aerial electrodes." J. T. Szek. September 28th.

20,344. "Improvements relating to filaments for electric incandescence lamps." R. de Fazi, F. G. Claussen and G. T. B. Cobbett. September 28th.

20,346. "Flexible electric compressor or heating pad for treating the body by electrically generated heat." C. M. Holmquist. September 28th.

20,352. "Improvements in apparatus for use as resistances in electric circuits." M. Hankin and F. Wolff. September 28th. (Complete.)

20,415. "Improvements in telephoto lenses." O. E. Wheeler. September 29th.

20,447. "Improvements in stranded electric cables." C. J. Beaver and A. E. Claremont. September 29th.

20,451. "Improvements in wire-covering machines." F. Hutchins and W. A. Phillips. September 29th.

20,466. "Improvements in wireless signalling." R. A. Fessenden. (Date applied for under Sec. 91 of the Act, October 10th, 1907, being date of application in United States.) September 29th. (Complete.)

20,468. "Improvements in time element devices applicable to electric circuit breakers and other apparatus." J. G. Statter. September 29th.

20,472. "Improvements in brake-blocks, electric collector shoes and the like." J. W. Taylor. September 29th.

20,491. "New or improved electrical fog signalling apparatus." D. Lewis and R. H. Jenkins. September 29th.

20,494. "Improvements in insulated joints for railway rails and the like." R. C. S. Woods. September 29th.

20,498. "Improvements in and relating to protective devices for alternating electric current systems." British Thomson-Houston Co., Ltd., and E. B. Wedmore. September 29th.

20,505. "Therapeutic apparatus for treatment with magnetic radiators, electric light rays and other agents." J. Willig. September 30th.

20,511. "Improved automatic stop and cut-out." P. A. E. Armstrong. September 30th.

20,565. "Improvements in electric lamps." A. J. Bonnella. September 30th.

20,575. "Improvements in trolley poles for trams and like electrically-driven vehicles." S. Bryan. September 30th.

20,578. "Improvements in armature-testing apparatus." V. Patton. September 30th. (Complete.)

20,582. "Improvements in standard or pedestal electric light fittings." C. H. Fisher. September 30th.

20,590. "Improvements in or relating to electric switches and switch arrangements." H. J. Fisher, F. Coates, H. W. Clothier and A. Reyrolle & Co., Ltd. September 30th.

20,600. "Improvements relating to signalling telegraphs." Siemens Bros. and Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) September 30th. (Complete.)

20,601. "Improvements relating to electrically controlled railway signals." Siemens Bros. & Co., Ltd., and L. de M. G. Ferreira. September 30th. (Complete.)

20,633. "Improved electrical recording instrument." H. Bevis and J. W. Penicud. October 1st.

20,638. "Improvements in and relating to secrecy systems for wireless communication." L. de Forest. October 1st. (Complete.)

20,646. "Improved construction of quick make-and-break electrical switch." Veritys, Ltd., and W. G. Pipkin. October 1st.

20,647. "Improvements in and relating to overhead electric wires for tramcars." J. Ormston and W. E. Charlton. October 1st.

20,661. "Apparatus for indicating and/or recording differences of electrical potential." W. A. Legge and F. A. Scott. October 1st.

20,671. "Improvements in telephone instruments." W. R. Daniells. (Date applied for under Sec. 91 of the Act, April 10th, 1908, being date of application in United States.) October 1st. (Complete.)

20,680. "Improvements in switches." W. M. Mordey. October 1st.

20,708. "Improvements in electric switches." B. R. Kor. October 1st.

20,714. "Improved system of and apparatus for controlling traffic on single line railways." A. Woodman. (W. A. Peloquin, Cosserat, India.) October 1st.

20,715. "Improved process of repairing electric metal filament incandescence lamps." H. Sefton-Jones. (H. Kuzel, Austria.) October 1st. (Complete.)

20,717. "Improvements in and relating to consumers' electricity meters." J. S. Highfield. October 1st.

20,718. "Improvements in the manufacture of metallic frictional blocks, such as brake blocks, electrical collector slippers and the like." W. Taylor. October 1st.

20,721. "Improvements in or relating to the control of electric motors." J. G. V. Lang and The Johnson-Lundell Electric Traction Co., Ltd. October 1st.

20,758. "Improvements in electrical fuses." B. Thomas and E. Thomas. October 2nd.

20,764. "Improved method of and apparatus for controlling the voltage of dynamo-electric machinery, especially applicable to variable-speed generators." W. Stansfield and J. J. Hatt. October 2nd.

20,772. "Improvements in electrical relay devices." B. Thomas and E. Thomas. October 2nd.

20,786. "Improvements in and relating to the commutating of variable voltage continuous-current dynamos with commutating poles." Aktien-Gesellschaft Brown, Boveri & Cie. (Date applied for under Sec. 91 of the Act, February 29th, 1908, being date of application in Germany.) October 2nd. (Complete.)

20,787. "Improvements relating to the electrolytic decomposition of sodium and other chlorides in the manufacture of caustic soda and other useful products." R. J. Levy. October 2nd.

20,827. "Improvements relating to the starting of polyphase motors." Akt.-Ges. Brown, Boveri & Cie. (Date applied for under Sec. 91 of the Act, October 2nd, 1907, being date of application in Germany.) October 2nd. (Complete.)

20,858. "Improvements in processess and appliances for producing metallic articles and combined metallic and non-metallic articles by electro-deposition and in the articles so produced." F. I. Gibbs. October 3rd.

20,877. "Improvements relating to holders, sockets or like attachment fittings for electric lamps." F. W. Bayliss. October 3rd.

20,883. "Improvements in or relating to appliances for incandescent lighting." A. J. Boult. (L. Hooker, New South Wales.) October 3rd. (Complete.)

20,890. "Improvements in electrical fuses." H. J. Fuller. October 3rd.

20,895. "Improvements relating to relay apparatus for polyphase alternating current circuits." J. S. Peck. October 3rd.

20,897. "Improvements in and relating to rotary contact-breakers particularly applicable for use with internal combustion engines." D. E. Brown and C. A. Vandervell. October 3rd.

20,915. "Process for fastening the filaments of electric incandescent lamps to the electrodes." T. McKenna. (Glühlampenwerk Anker G.m.b.H., Germany.) October 3rd. (Complete.)

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1907.

Electrical Transmission of Power. H. A. Mavor and Mavor & Coulson, Ltd. 13,724. June 18th.

Trembler Induction Coil Ignition Systems. S. J. Watson and G. H. Smith. 20,347. September 12th.

Electrical Clock. F. Schneider. 20,380. September 12th.

Electric Batteries or Cells. P. Rabbidge. 20,592. September 16th.

Electro-Magnetically Controlled Cut-Out or Circuit-Breaker. H. Rose. 20,612. September 16th.

Windings of Dynamo-Electric Machines. Siemens Bros. Dynamo Works, Ltd., and M. Kloss. 21,078. September 23rd.

Receivers for Wireless Telegraphy. Marconi's Wireless Telegraph Co. and A. M. Young. 21,651. September 30th.

Electric Motor Controllers. British Thomson-Houston Co. (General Electric Co., United States.) 23,915. October 30th.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co., United States.) 25,116. November 12th.

Means of Paralleling the Motors of Electric and Petrol-Electric Cars. W. A. Stevens. 25,772. November 21st.

Electric Order Telegraphs. Petch, Duncan and King. 26,195. November 27th.

Spanner for Insulators. H. O. Klauser. (Geb. Gierse, Germany.) 26,711. December 3rd.

Electric Signalling System for Railways. A. Gardiner. 28,435. December 27th.

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Electrically-Controlled Locks Particularly Applicable to Carriages and like Vehicles. Soc. Ch. Legrand et Cie. 6,764. March 26th. (Date applied for under International Convention, March 29th, 1907.)

Incandescent Filaments for Electric Incandescent Lamps. Wolfram Lampen Akt.-Ges. 8,421. April 15th. (Date applied for under International Convention, May 18th, 1907.)

Interrupter for the Ignition Systems of Internal-Combustion Engines. J. E. Henrique. 8,713. April 21st. (Date applied for under International Convention, April 20th, 1907.)

Electric Indicating Meter for Controlling the Duration of Telephone Conversations. H. Roost. 12,336. June 6th.

Protective Cover for Electric Glow Lamps. Siemens Schuckertwerke Ges. 14,910. July 24th. (Date applied for under International Convention, June 1st, 1908.)

Automatic Trolley Controlling Devices for Use on Electric Tramcars and the like. J. R. Willey and F. Worsley. 16,076. July 29th.

Electric Current Transformers. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges., Germany.) 16,208. July 30th.

Electric Lamp and Shade Holders for Oil Lamp Reservoirs. A. H. Entwistle. 136. January 2nd.

Electrically-Driven Mining Machines. P. Jensen. (J. A. Jeffrey, United States.) 1,250. January 18th.

Device for Determining the Deviations of Bore-Holes from the Vertical and for Localising Magnetically Disturbed Spots. K. Haussmann. 1,821. January 27th.

Process for Producing Positive Storage Battery Plates. J. A. d'Vard and A. Meislinger-Meszlenyi. 4,940. March 4th.

Tramways as Electricity Supply Undertakings.—

The question whether a tramway company can supply surplus power to private consumers was recently decided by the Lille Tribunal of Commerce, in the case of a dispute between the Lille Tramways Co. and the Lille Electric Lighting Co. It appears that the tramway company obtained administrative authority through the Prefect of the North to sell its surplus power to private individuals, the permission being accompanied by certain conditions, which were duly specified. But the lighting company, which has a monopoly of electric lighting and also holds the concession for the distribution of electric power, contended that the tramway company was offering unfair competition, and that the latter should restrict its activity strictly to the object of its concession. The Tribunal non-suited the lighting company, both on a question of fact and on one of law. The Court held that a tramway company could not produce energy with mathematical accuracy so as to meet the actual requirements for working the traffic, but that material variations must take place owing to the difference in traffic. The energy furnished by the tramway to power users arose from the difference between the quantity utilised on Sundays and holidays, when the number of passengers carried was considerable, and on other days, when the traffic was not so extensive. Thus the surplus was not intentionally generated for sale, but was a result of the working of the undertaking itself, and did not necessitate any special appropriation of capital for the purpose. The company did not deviate from its concession in taking advantage of the opportunity; it merely utilised an accessory product, according to the decision of the Court, which one could not equitably compel it to leave unused, and the restricted importance of which was limited and controlled by the administrative authority, who took as the basis of their authorisations the normal production proportioned to the actual requirements of working. It was further held by the Court on the ground of fact that the surplus was of insignificant importance as compared with the energy consumed within the area served by the tramways, and that its sale became a negligible quantity in the general consumption, whereas the case would be quite otherwise if the company produced energy for the purpose of disposal to private users. In these circumstances the Court rejected the demand of the lighting company on the question of fact, and the Tribunal was equally decisive on the point of law.